Vol. 15 No. 1 January 1961 Published Monthly

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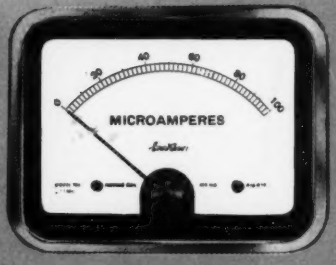
INSTRUMENT PRACTICE

CONTROL SYSTEMS-ELECTRONICS-AUTOMATION

Instrumentation in Television



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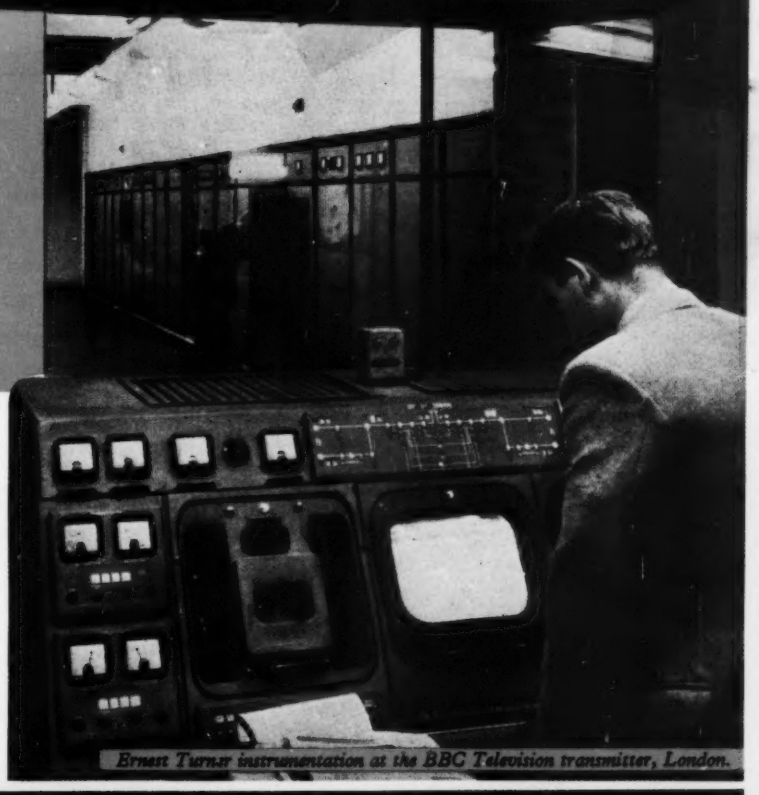

Ernest Turner instrumentation at the BBC Television transmitter, London.

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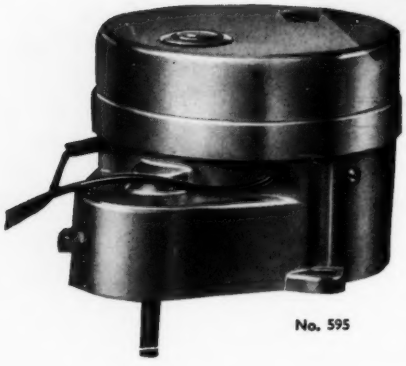

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Immediate Delivery — Instruments ranged 0-120°C, 0-200°C, 0-300°C and 0-500°C available from stock in Manchester, London, Walsall, Stockton and Edinburgh. Other standard ranges in stock at Manchester. Telephone your urgent requirements to Wythenshawe 3251, Trafalgar 3154, Walsall 28343, Stockton 68617 or Craig Lockhart 5235 (A. R. Bolton).

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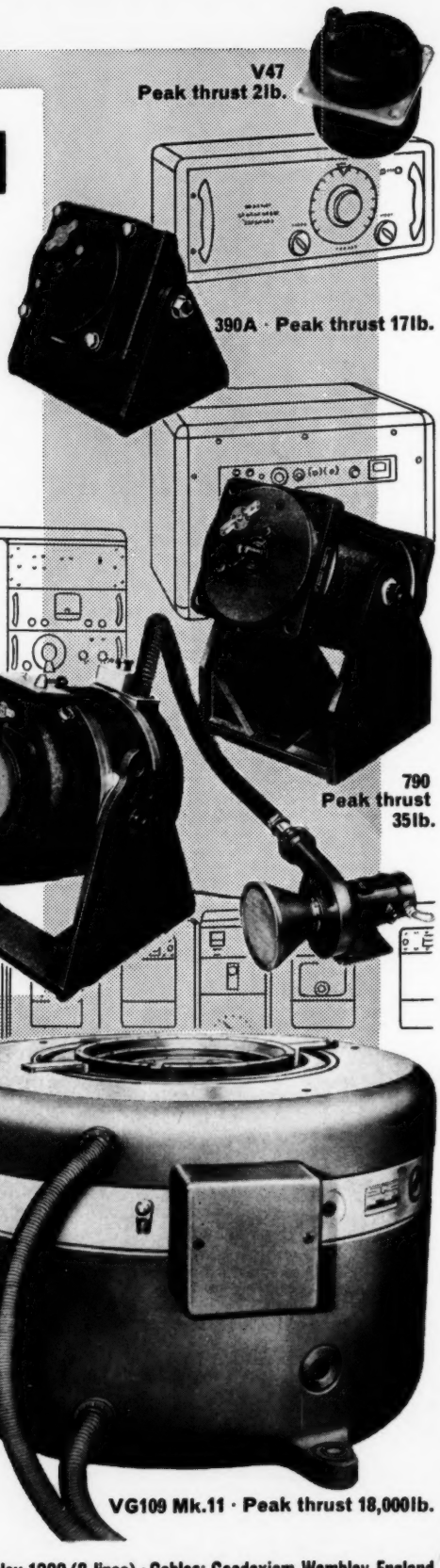

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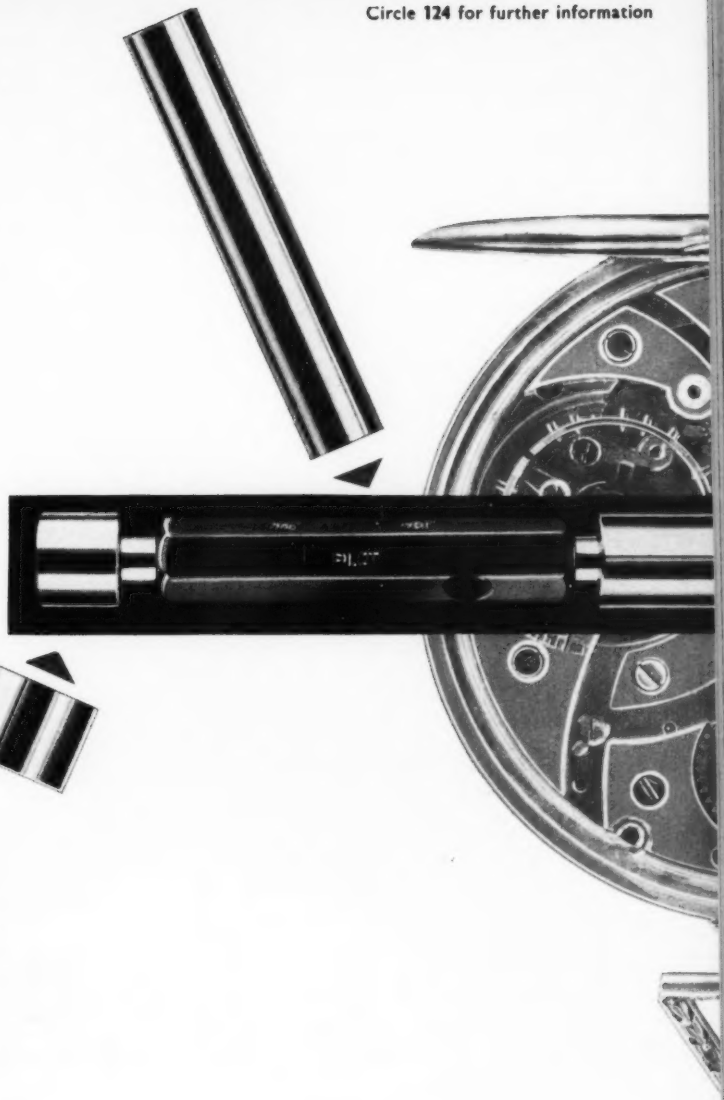
A series to acquaint engineers with the very practical advantages of PILOT plug gauges which ***reduce*** *gauging costs.*



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It will be appreciated that a plug gauge resembles a watch....two penny-worth of material and five pounds' worth of skill. Because of this obvious fact Pilot buy the very best steel it is possible to procure, and if a superior specification could be obtained at twice the price in order to improve the performance and enhance still further the reputation of PILOT we would use it. All steel in Pilot gauges, bars or forgings, is hammered and rolled to ensure maximum results, but this of course is much more costly than drawn rod. It is a fact that a 'cheap' gauge without finish hardness, 'top limit' and accuracy, and made from nondescript material is a very poor investment in the end.

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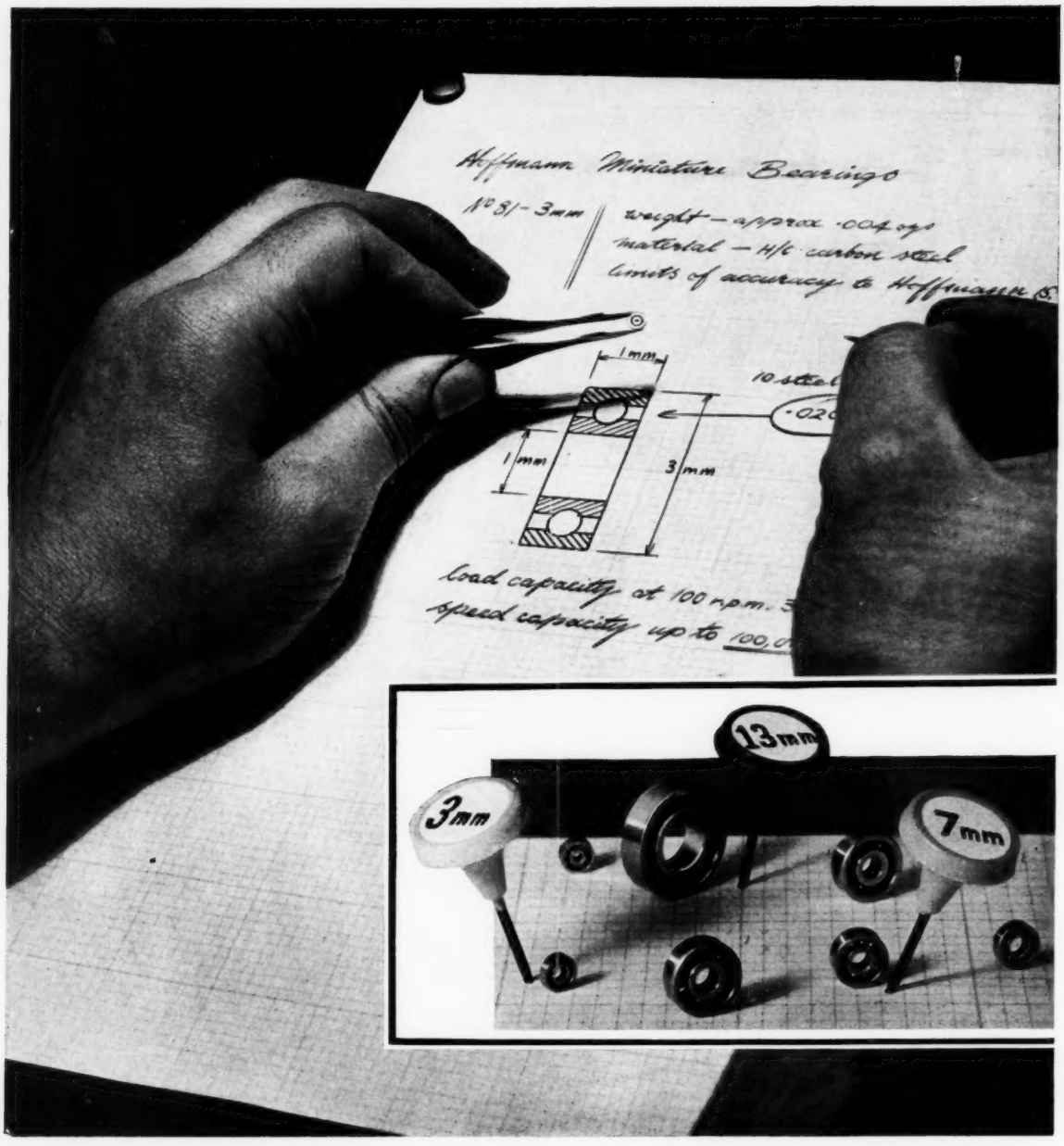

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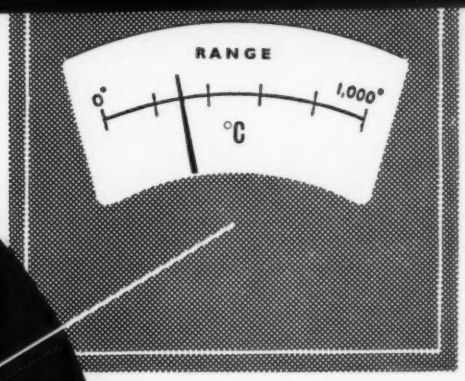

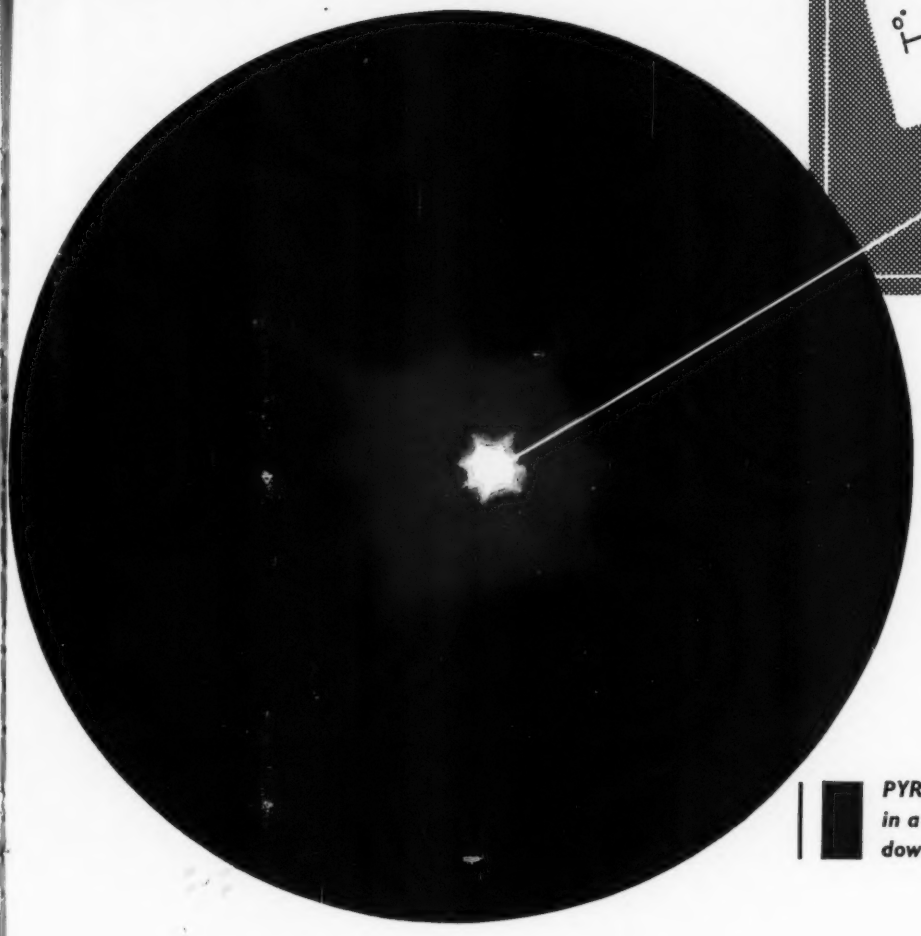

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TYPE ACP. Servo Operated Piston Type. Will handle liquids and gases at high pressure with a small expenditure of electrical power.

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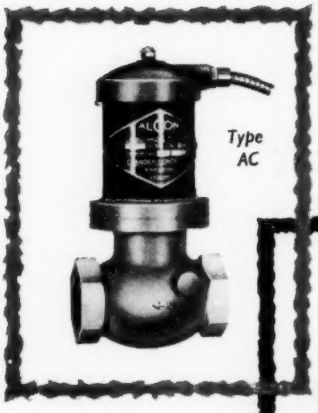

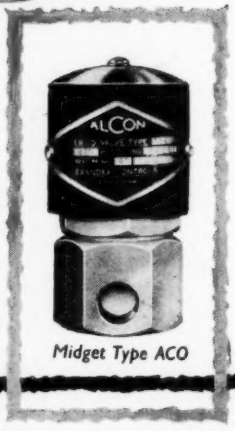

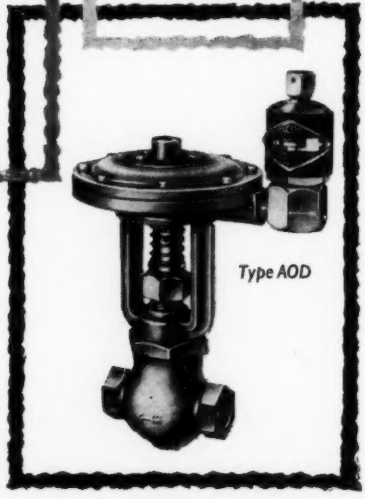

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T1* & T2*

Thermocouple Wires

THE FACTS

T1* and T2* are thermocouple wires of the nickel-chromium/nickel-aluminium type. They are suitable for constant use at temperatures up to 1100°C, and for spot readings at higher temperatures.

T1* and T2* conform to the relevant British Standard and Air Ministry specifications. They are entirely British made. They are protected by registered trade marks.

So much for the basic facts. T1* and T2* are thermocouple alloys whose stability, life, and quality generally are taken as read by so many pyrometer manufacturers. But these alloys also pass with flying colours the kind of tests by which a first-class *commercial* proposition is judged.

Made in Britain The commercial advantages of material manufactured entirely in this country are perhaps self-evident. Lines of communication are short and to the point. We can have a finger on the pulse of the market. And, most important of all, we can give an all-round service worthy of products which are very good indeed.

Small Quantities — Because of the special nature of the thermocouple market, we are geared to supplying as little as a few ounces of T1* and T2*, if that is all you need.

— And Large Which is not to say that we aren't fully able to cope with orders in the upper poundage bracket.

Wire or Strip Both are in constant production in a range of standard sizes (and their metric equivalents).

'Specials' Non-standard sizes or unusual profiles can be supplied.

Delivery Both T1* and T2* are manufactured in this country and are in daily production. Consequently there are clear advantages in delivery.

Technical Advice A well-informed objective opinion on a thermocouple problem may well be worth having. Free and without obligation, of course. **Regd. Trade Mark*

Data Sheet No. 2 contains technical data concerning our thermocouple alloys. Copies are available free of charge on request.

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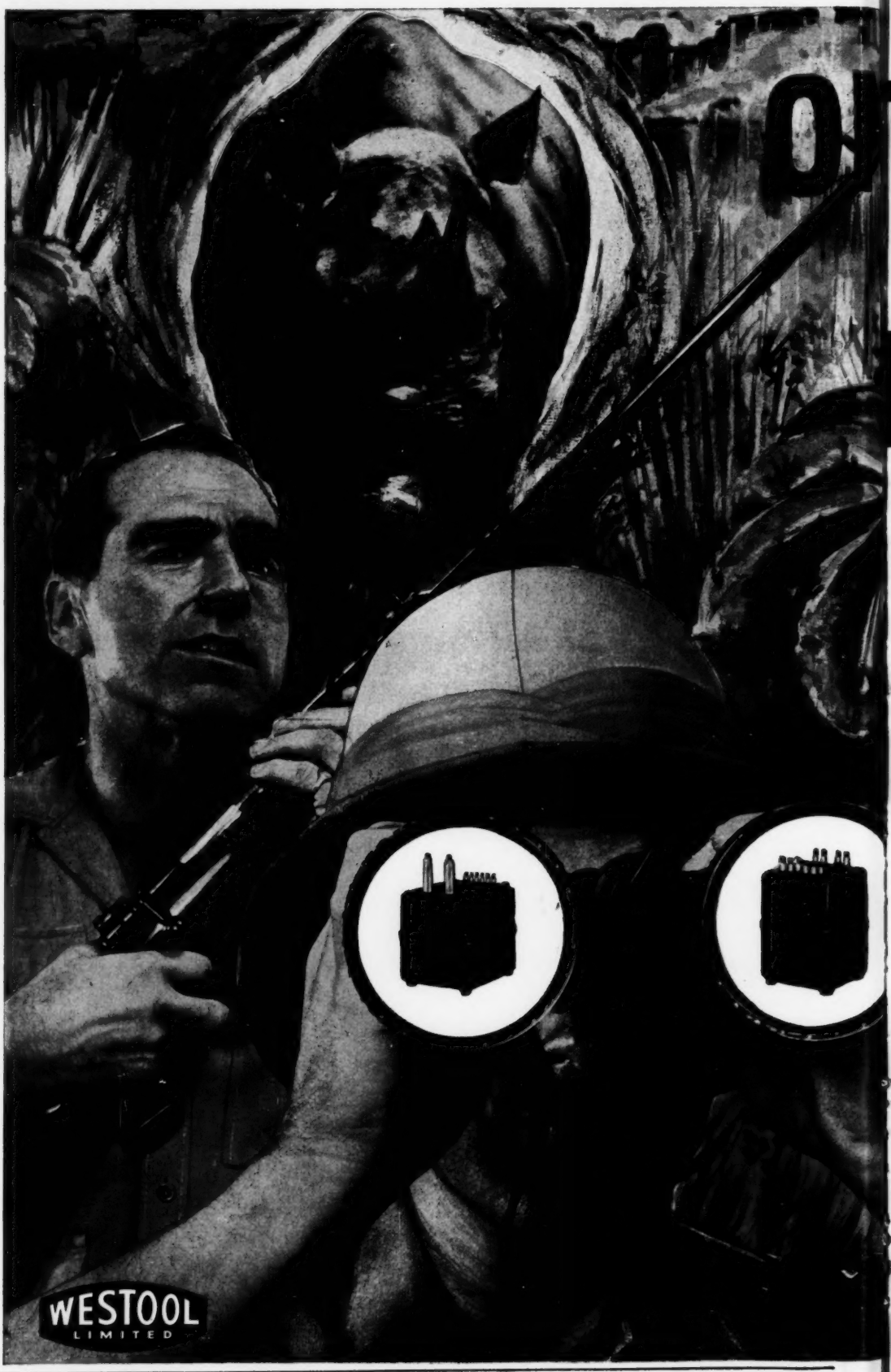

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"Gadsby, you hoary old hunter, you're dead right – it's Westool!
... finest herd of transformers I've seen in twenty years of safari!
I'll bag the open type bunch ... you take the fully shrouded fellows,
and we'll share the encased and hermetically sealed ...
remember they're Westool, they're tough ... stand up to almost anything
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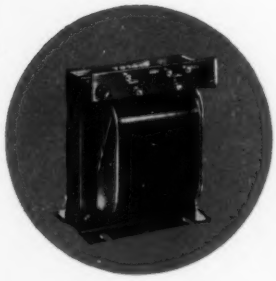
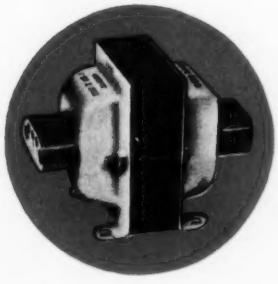
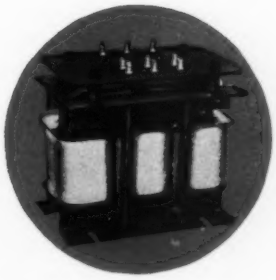
Westool transformers from the smallest possible up to 1,500 VA for sealed can types; 5kVA single phase— 18kVA three phase. Transformers to BS specifications or to customer's own requirements.







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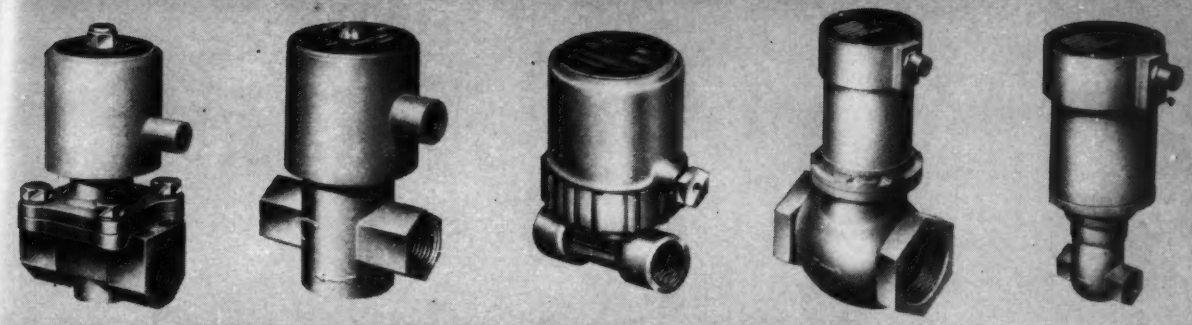
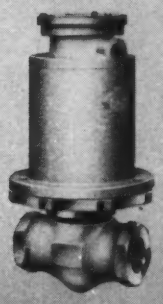
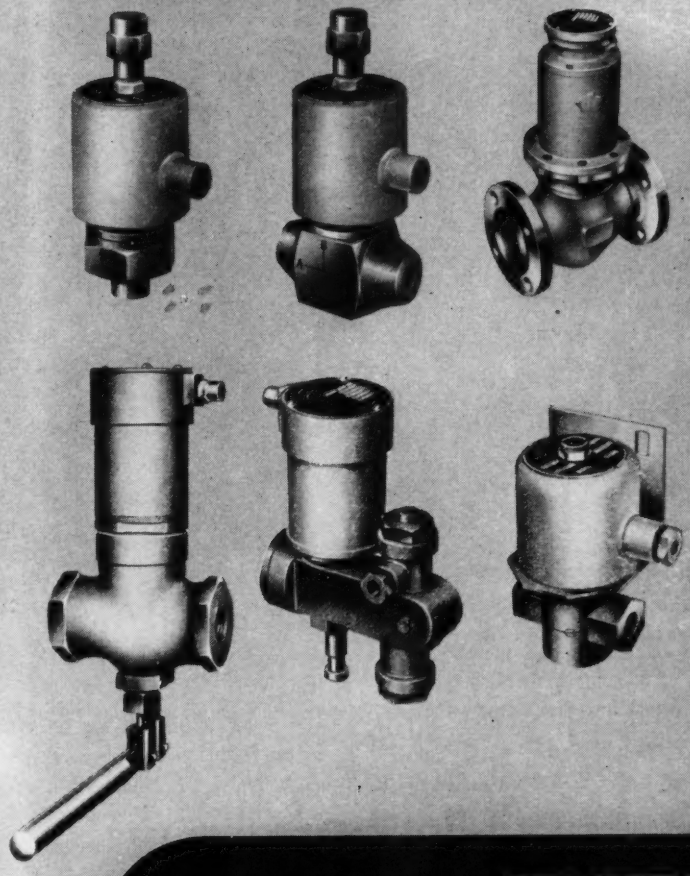


For any type of SOLENOID VALVE — *whatever your need*





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If the solenoid valves you require are not included in our comprehensive standard ranges, our Design Engineers will gladly develop special types to suit your requirements. Whatever your need, send us your enquiries for prompt attention.

Custom-built for a Swedish atomic energy application, this stainless steel solenoid valve is used for controlling radio-active heavy water at temperatures up to 250°C.

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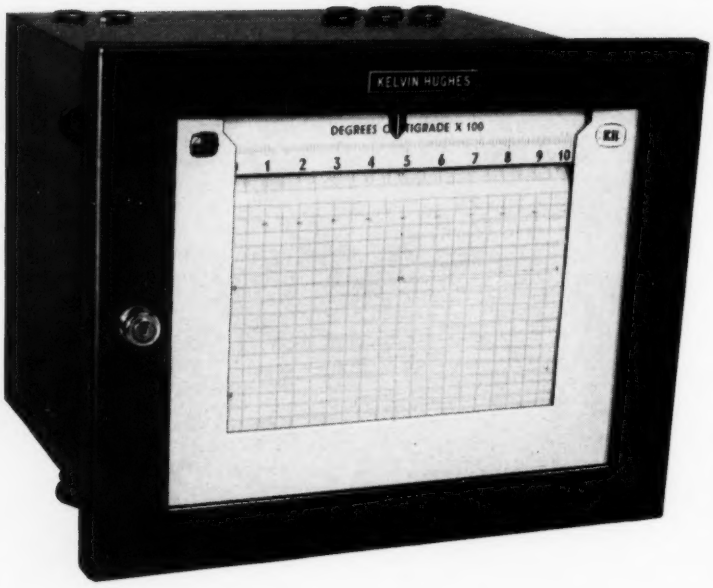
NO wear to impair accuracy with SMITHS

NEW POTENTIOMETRIC RECORDERS



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★ Infinite Resolution: Variable force balance current generator gives improved performance in sensitivity and accuracy.

★ No Standardising: Highly stabilised zener-diode d.c. supplies obviate the need for standardising.

★ Dead-beat Balancing: Brushless tacho-generator eliminates overshoot.

★ Six Chart Speeds: 2, 4 or 8 in/hr. and 4, 8 or 16 cm/hr. selected by inter-change gear wheels.

★ Clear Chart Presentation: 8 in. long, 10½ in. wide chart exposed. Strip light optional.

★ Remote Indicators: Operated from basic instrument without adding secondary components.

★ Plug-in Range Changing.

★ Accessibility.

SMITHS introduce a series of new Potentiometric Recorders for continuous duty applications in industrial processes and laboratory investigations in research establishments. These instruments measure d.c. input voltages down to the range 0-1 mV, and are suitable for use with thermocouples, resistance bulbs, strain gauges, load cells and other transducers.

No slide-wire is used in the SMITHS system, thus the main source of wear and subsequent loss of accuracy inherent with other null-balance type instruments does not arise.

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TGA S/K102

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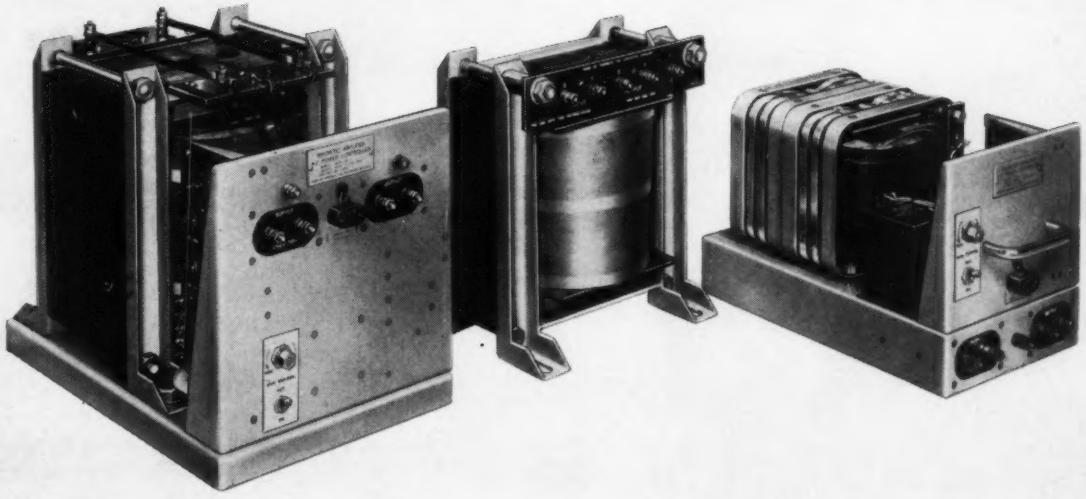
PARMEKO

MAGNETIC AMPLIFIER A.C. POWER CONTROL UNITS



These units have been designed to control A.C. power loads and find many applications in the controlling of power to furnace elements, incandescent lamps, rectifier equipments, etc. Being robustly constructed and containing no moving parts, they require no maintenance during the course of their almost indefinite life. In operation, the heat they generate is negligible and consequently they may be fitted into cubicles of smaller dimensions than would be acceptable for equivalent types of control. The standard range is comprised of models rated at 1 KVA, 3 KVA, 5 KVA, 8 KVA and 10 KVA and designs for other powers can be readily made available.

For full information and technical leaflet write to—

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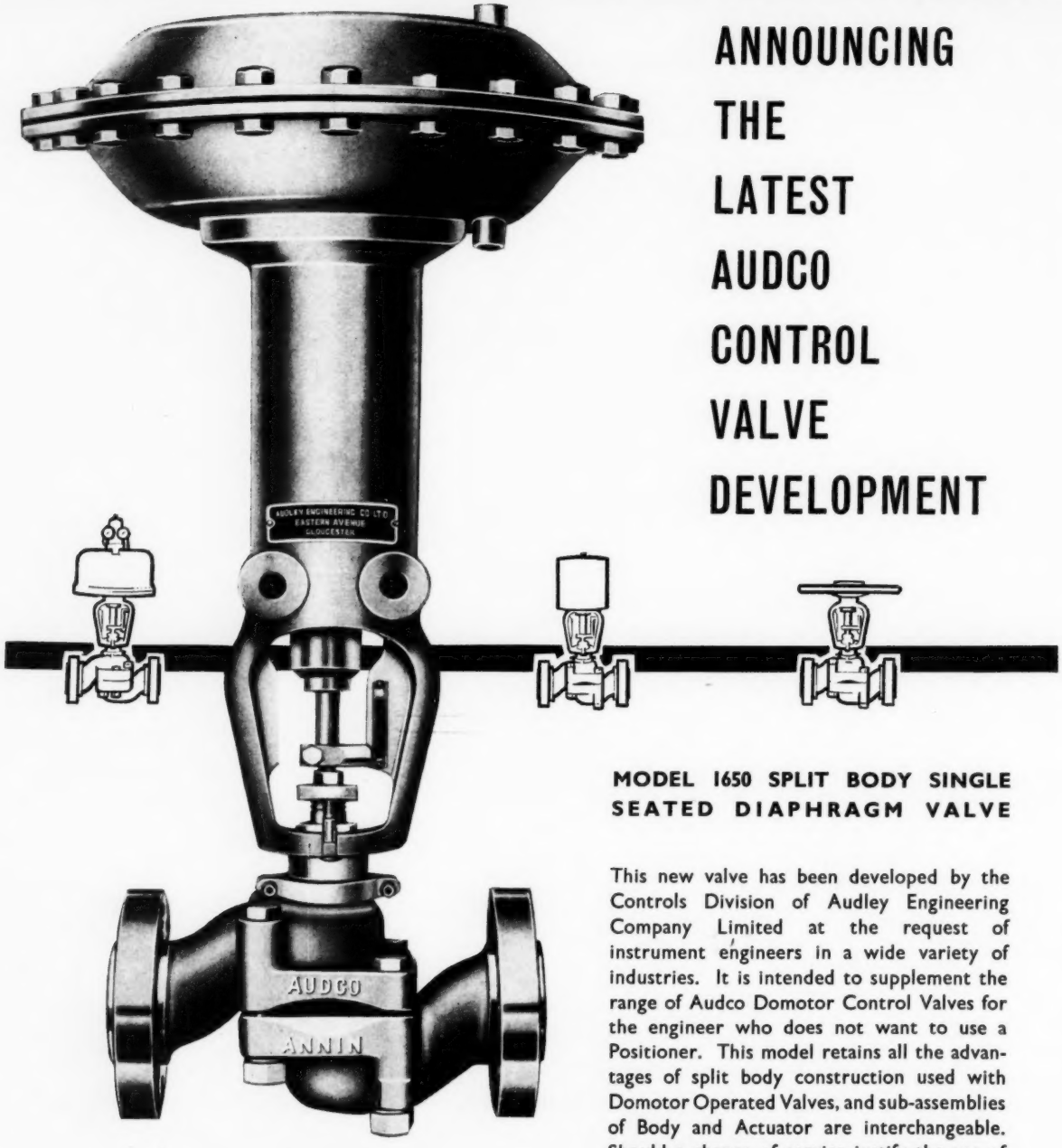

ANNOUNCING THE LATEST AUDCO CONTROL VALVE DEVELOPMENT

MODEL 1650 SPLIT BODY SINGLE SEATED DIAPHRAGM VALVE

This new valve has been developed by the Controls Division of Audley Engineering Company Limited at the request of instrument engineers in a wide variety of industries. It is intended to supplement the range of Audco Domotor Control Valves for the engineer who does not want to use a Positioner. This model retains all the advantages of split body construction used with Domotor Operated Valves, and sub-assemblies of Body and Actuator are interchangeable. Should a change of service justify the use of a Positioner, it is possible to mount this on the top or side as desired. The valve body is produced in a variety of metals including cast iron, stainless steel and bronze, and is available in sizes up to 2".

AUDCO CONTROL Valves

AUDLEY ENGINEERING CO. LTD., AUDCO CONTROLS DIVISION, EASTERN AVENUE, GLOUCESTER. Tel.: Gloucester 21451/5

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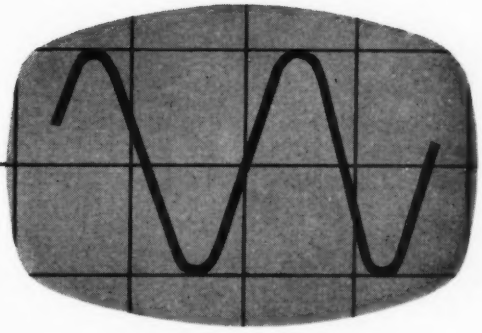
STABILIZED SINUSOIDAL VOLTAGE



by Advance

the CVH RANGE

VOLSTAT

Advance constant voltage transformers are available in the CVH range with low harmonic distortion in the output waveform, ideal for use with precision equipment sensitive to power frequency harmonics, and also with all equipment requiring a constant voltage sinusoidal input.

In most applications the harmonic distortion present in the output waveform will not exceed 3%. Under the most unfavourable conditions this figure will not rise substantially above 5%. When used with a rectifier to provide a d.c. supply, the characteristics of the system are identical to the normal mains source and particularly close regulation of the output is obtained.

- Continuous and Automatic Stabilization
- Rapid Response Time
- Current Limiting Characteristic
- Compact Design
- No Moving Parts
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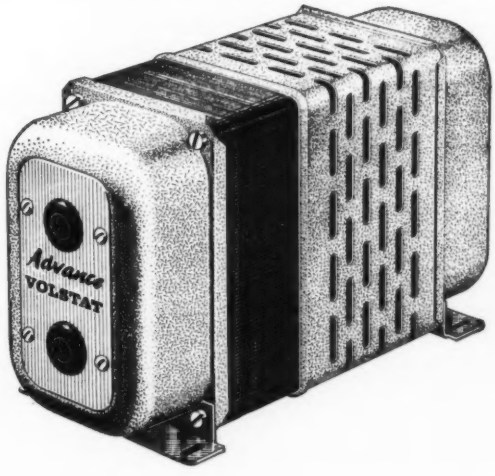

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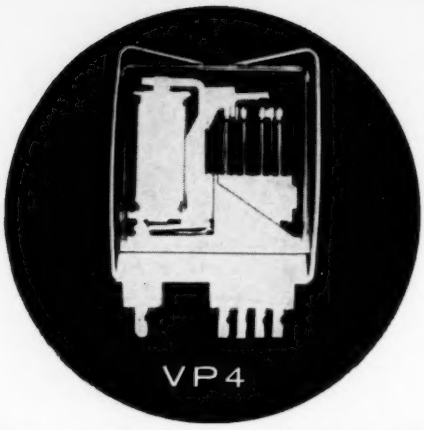

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0— 250 V.	
0—1000 V.	**D.C. Current**
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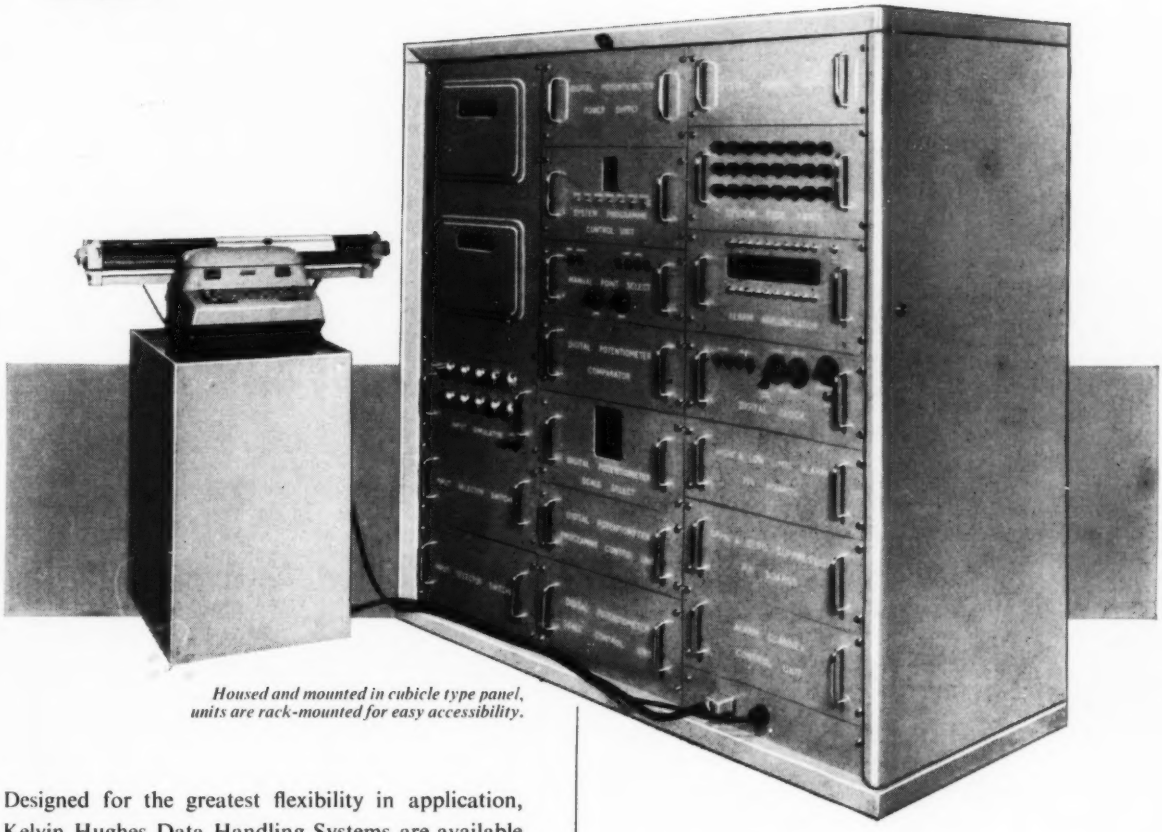

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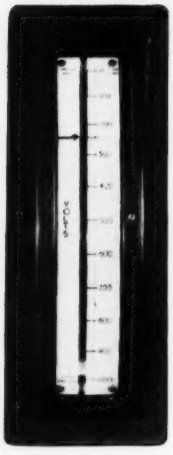

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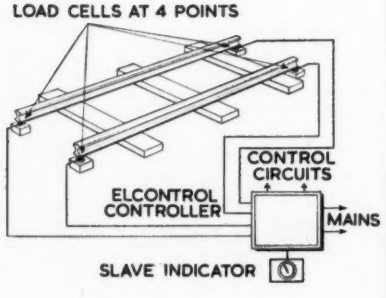

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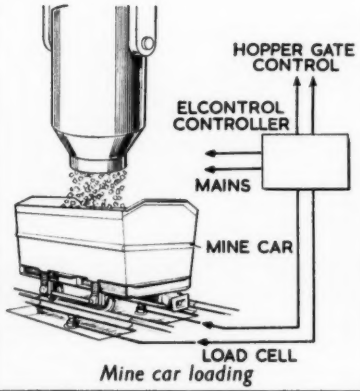
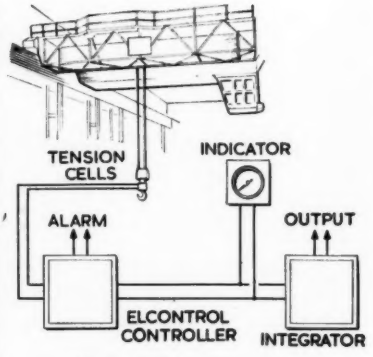
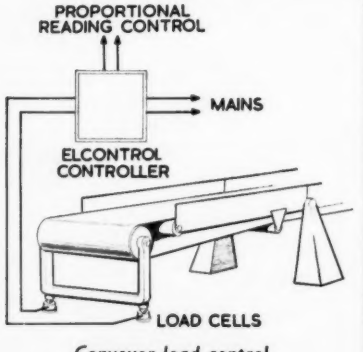


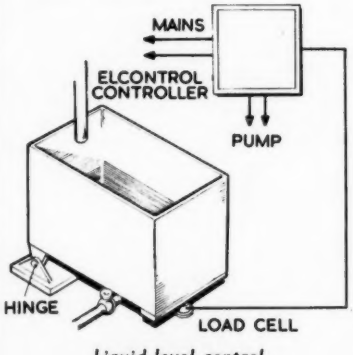
Mine car loading



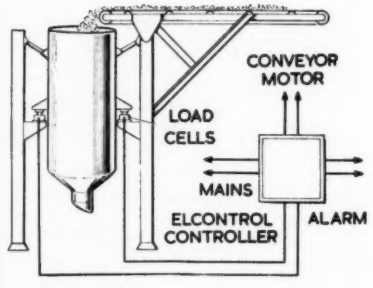
Hoist load limit control



Conveyor load control



Liquid level control



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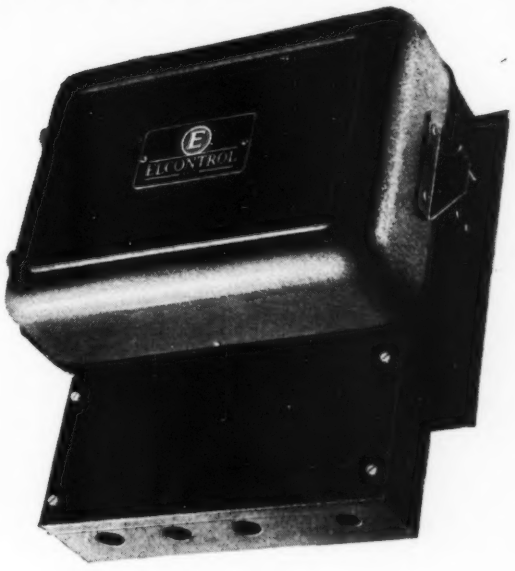
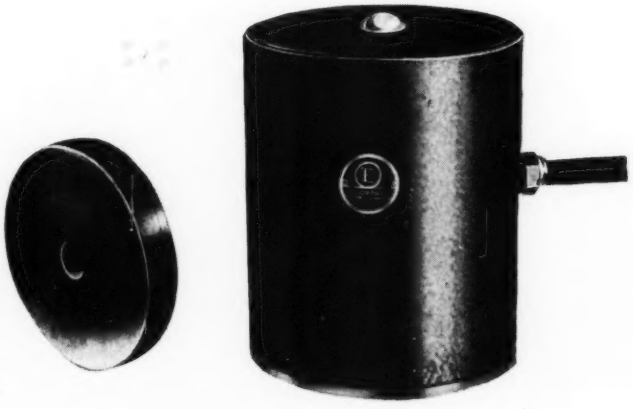


LC4/LC5 Control Unit closed.



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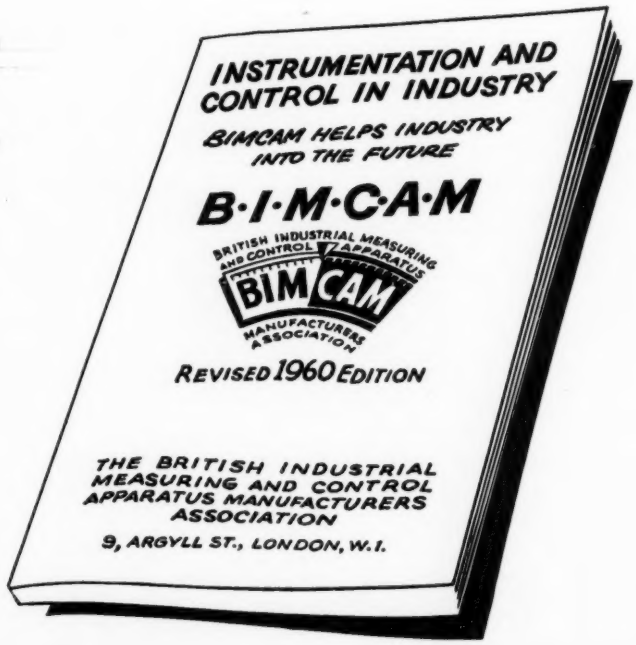
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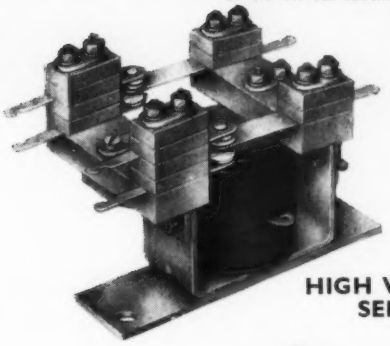

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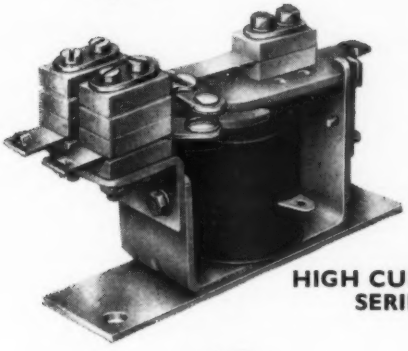

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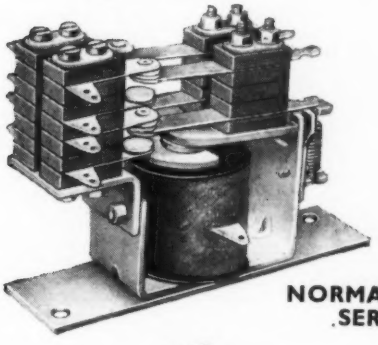

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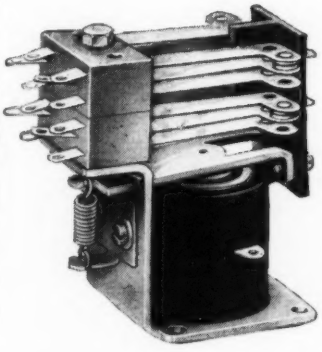

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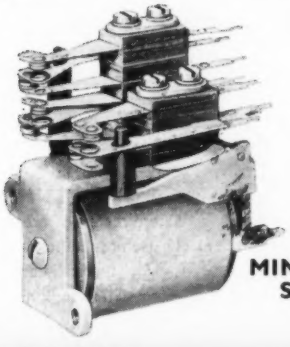

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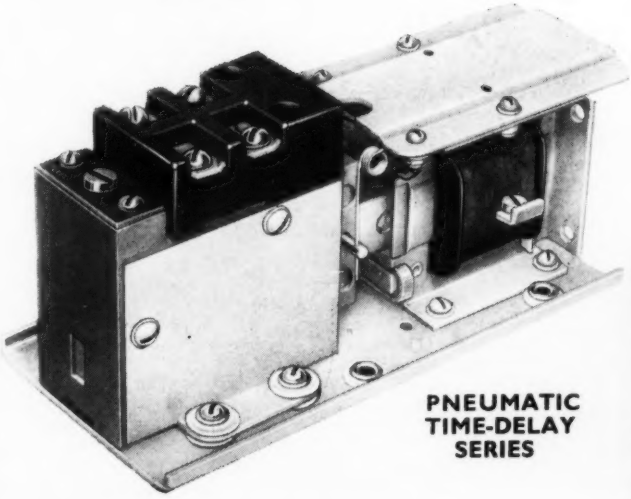

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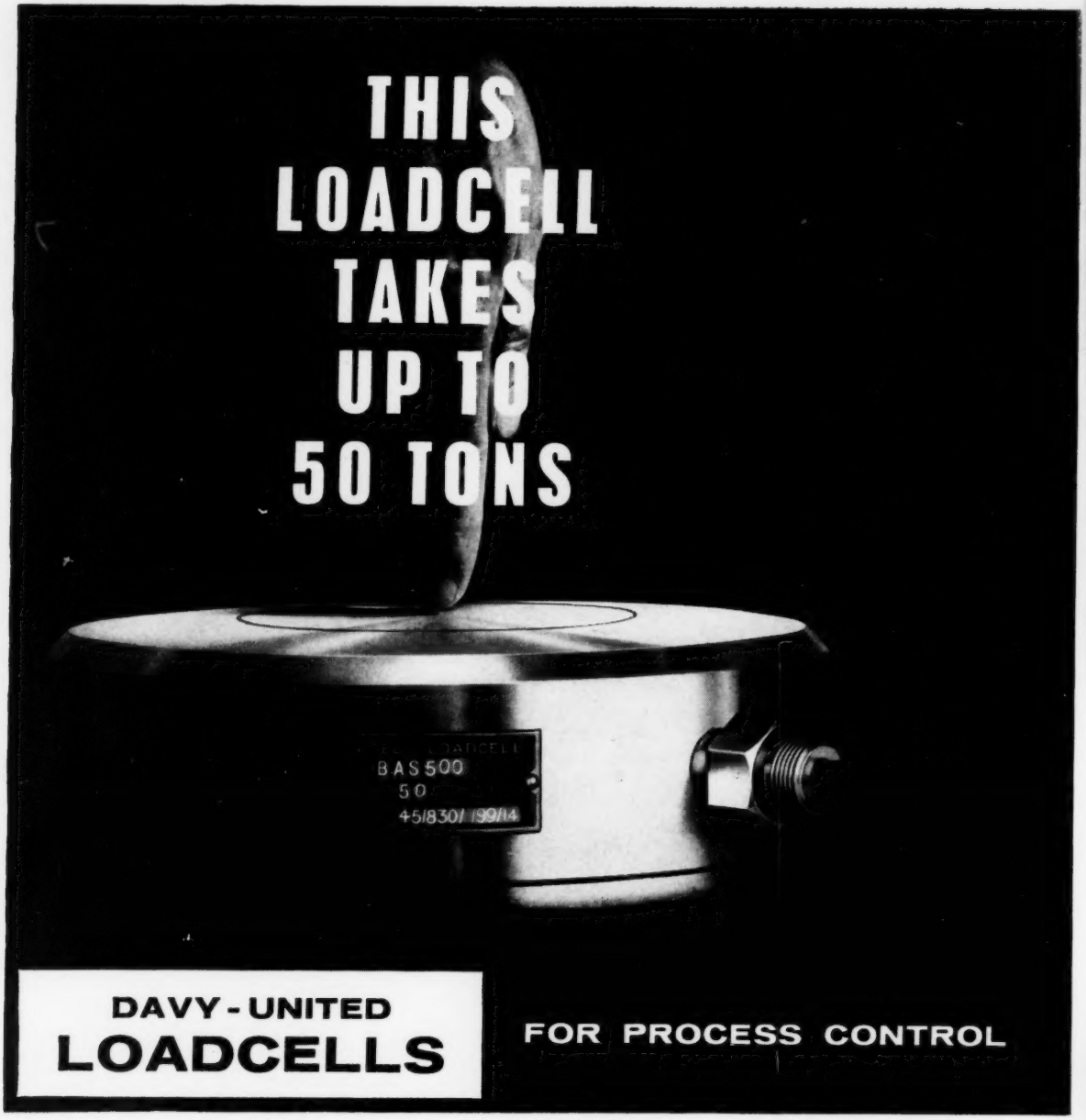

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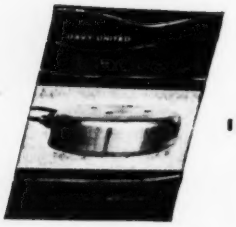

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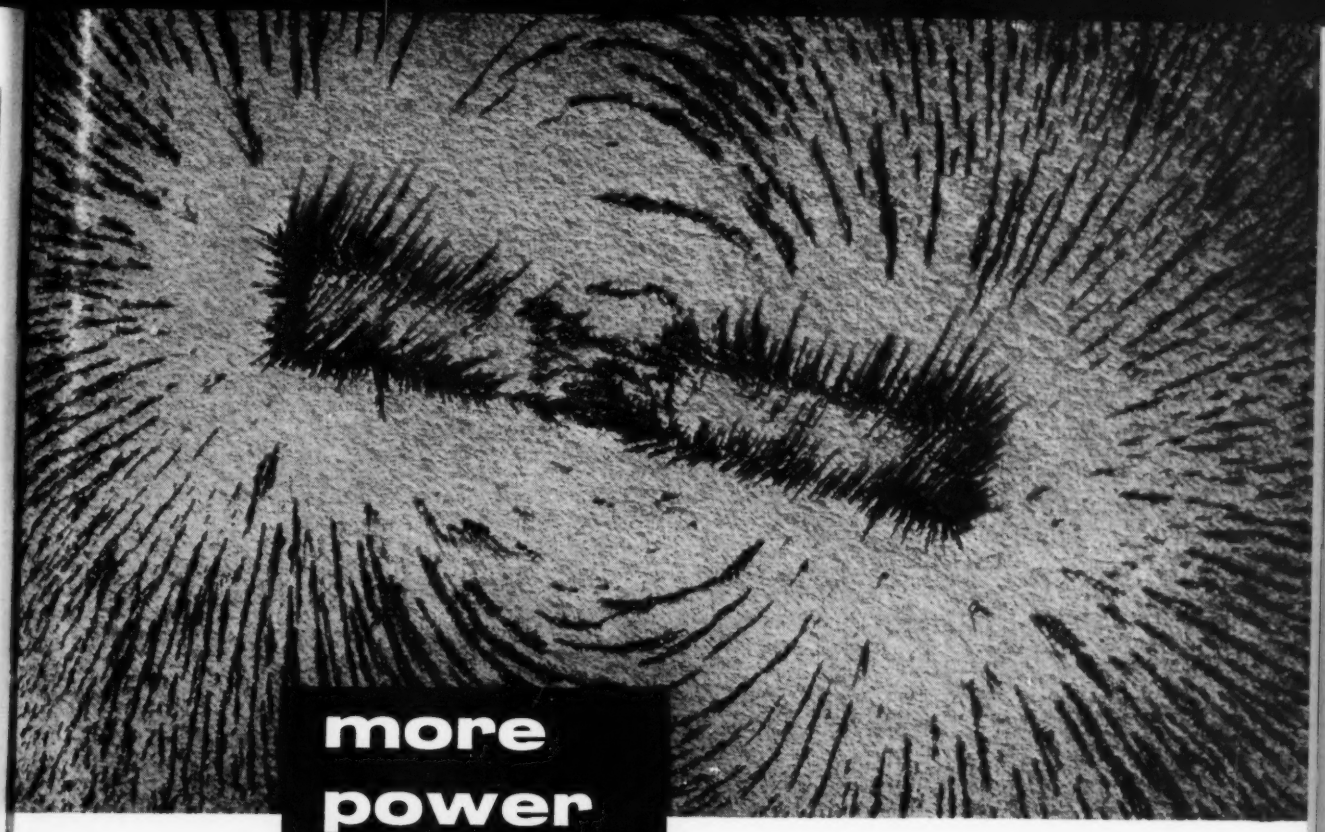

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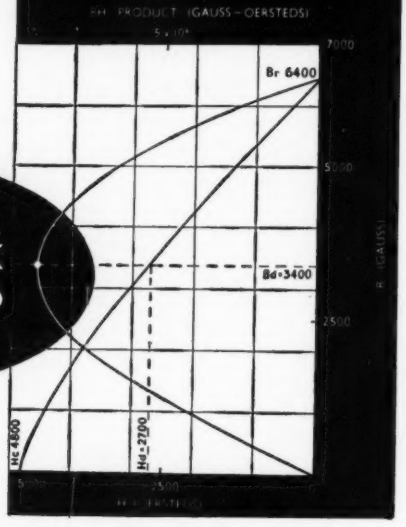

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Send for leaflet No. S.K.50 6002 IP

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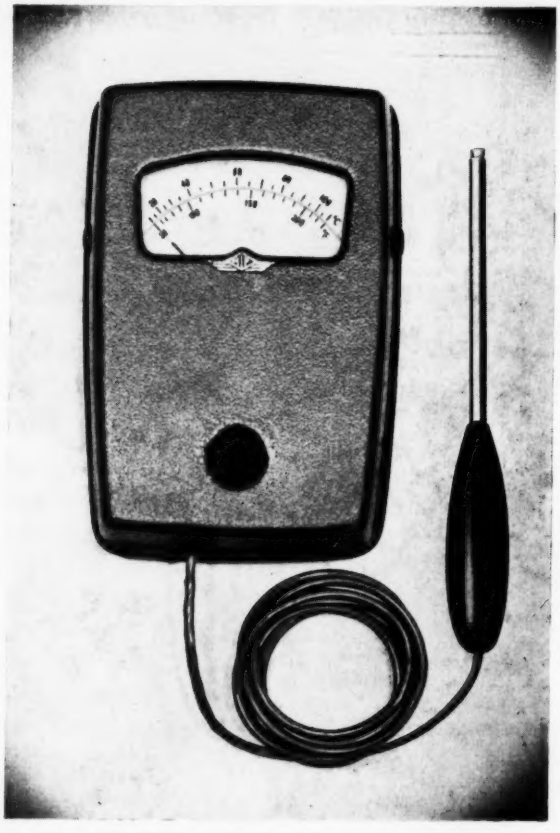
SALFORD ELECTRICAL INSTRUMENTS LTD.

PEEL WORKS, SILK STREET, SALFORD 3, LANCS. *Tel:* Blackfriars 6688

London Sales Office: Magnet House, Kingsway, W.C.2. *Tel:* Temple Bar 4668

A Subsidiary of THE GENERAL ELECTRIC CO. LTD. OF ENGLAND



M.I.P.
THERMETER

The most versatile electric thermometer ever made. Measures surface gas or liquid temperature in a few seconds. Small enough to go in a pocket, yet with a long enough scale to give accurate measurements. Temperature is read direct on a 3 in. anti-parallax scale.

Price £22 17s. 6d. complete with self-aligning probe and carrying case.

For further details please write to MAIN DISTRIBUTORS:

CHARLES ELEY
& SONS

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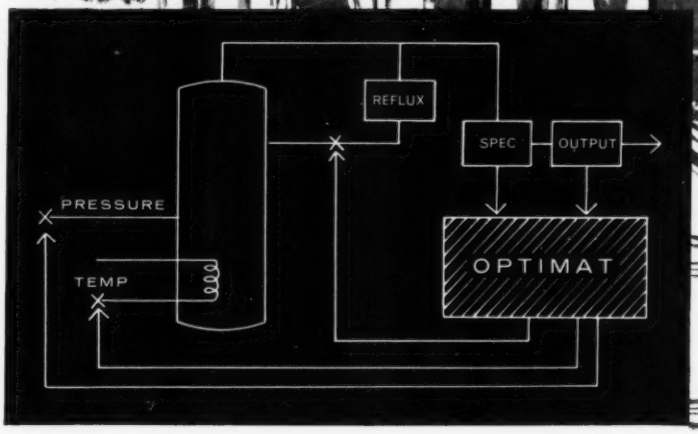
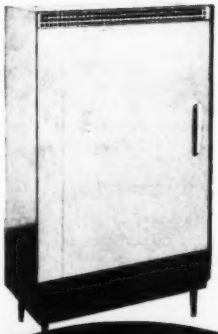
Circle **151** for further information

Circle 152 for further information

Optimising plant efficiency



A new concept in the field of continuous process control maximises process efficiency by a continuous and automatic adjustment of the independently variable process quantities, so that the overall performance of the process is optimised.



The Optimat is self-adaptive in operation and no knowledge of plant mathematics is required. The machine accepts process input signals and operates on up to three conventional three-term controllers. Controller set points are adjusted to optimise plant performance while the product is retained in specification limits.

PANELLIT

'OPTIMAT'

OPTIMISING CONTROLLER

* **Self-adaptive**
* **Solid state**
* **Low cost**

PANELLIT

Detailed Information from:

PANELLIT LIMITED

Elstree Way, Borehamwood, Herts. *Elstree 2040*

A member of the Elliott-Automation Group

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Ketay

High Precision Size 15 Compensated Resolver 105D2V

The 105D2V is a high precision, high impedance Size 15 Resolver with a resolution error of 0.1% and feedback or compensation windings on the stator for application in high performance computer systems.

This Resolver (USA BU-ORD MARK 4—MOD 1 RESOLVER) provides accurate trigonometrical functions of a given input voltage or is used to interchange rectangular and polar co-ordinates. It can also be used as an accurate synchro in four-wire data transmission systems and as a precision phase shifter.

Through-bore construction is employed and every winding is terminated at an isolated screw type terminal block thus eliminating all internal connections.

TECHNICAL SPECIFICATION

Number of windings	Stator ...	2
	Rotor ...	2
	Feedback ...	2
Excitation winding	Stator	
Excitation frequency	400 c.p.s.	
Voltage Rating	26/26 volts	
Test Voltage	15 volts	
Input Impedance, Nominal ...	480(±15%)+j2500(±10%)	
Transformation Ratio ...	0.98±0.01	
Phase Shift	8.5°±0.5°	
Resolution Error	0.1%	
Null Point Error	5 mins	
Total Null Volts	15 mV	
Fundamental Null Volts ...	8 mV	
Tuned Impedance, Nominal...	10,000 ohms	
D.C. Resistance (Nominal), ohms	390 Stator 320 Rotor 520 Feedback	
Moment of Inertia	9.25 gm cm²	
Weight	6.2 ozs	
Operating Temperature Range	−55 +75°C	

KETAY LIMITED

Eddes House • Eastern Avenue West • Romford • Essex
Telephone: Seven Kings 6050

Overseas Sales Organisation: Plessey International Limited
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K13A

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Economac Range

GRAPHPLOTTERS

and data reduction equipment

Table top plotters with high powered A.C. servos and sound mechanical construction (also for wall-mounting)

★ Plotting areas 10" x 18", 30" x 18", 30" x 30" (25 x 45 cm., 45 x 75 cm., 75 x 75 cm.)
★ Sensitivity down to 10 mV/inch (0·35 mV/cm.)
★ Speeds up to 20"/sec. (50 cm/sec.)
★ Repeatable accuracy better than 0·2%.
★ Constant speed available X axis.
★ Variable or switched sensitivity controls.
★ Units with ball point pen or single symbol printer (interchangeable symbols).
★ Vacuum paper-hold optional.
★ Auxiliary units — Keyboards and punched card or punched tape input units. Also trace readers.

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(ELECTRONICS) LTD

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Circle 155 for further information

If your problem is one of controlling

GAS, AIR, OIL OR LIQUIDS

WE MAY HAVE THE ANSWER!

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AUTOMATIC CONTROLS LTD

CONTROL VALVES

Whatever the pressure, the application, or the temperature, one of the wide range of Black Control Valves is likely to meet your exact need—and if it doesn't—if it *can* be made—we can make one for you that will. Solenoid or diaphragm operated for general industrial applications or the more specialised requirements of the aircraft, guided missile or nuclear fields, Blacks may have the answer.

PRESSURE SWITCHES

The Black range of Pressure Switches has been designed for all kinds of pressure signalling and control not only for industrial applications but in the more specialised field of missile and nuclear research.

Specified by a rapidly increasing number of leading organisations throughout the country they are available for an extremely wide and accurate range of pressures—either standard or purpose made.
Send us your enquiry. Whatever the size, application, temperature or material—let us know your requirements—we are almost certain to be of assistance.

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AUTOMATIC CONTROLS LTD

BLACK AUTOMATIC CONTROLS LTD
Leafield, Corsham, Wilts. Telephone: Hawthorn 376-7

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CONTROL VALVES

HDOL/DOV 3-way valve. Diaphragm operated suitable for use on hydrogen at pressures up to 22,000 p.s.i. Size ⅛", ¼", ⅜" B.S.P.

HDO Fuel Oil Valve. Size ¼"—½" B.S.P. Low pressure, minimum pressure drop.

ST/2/B Straight Through in-line Valve. Air, gas or light oil. Pressures up to 100 p.s.i. Size ¼", ⅜" B.S.P.

DPS MKII Differential Pressure Switch. Standard pattern. Range 0-30" w.g. 30"-10 p.s.i. Details of high static and high differential models on request.

PRESSURE SWITCHES

FS MKII Flow Switch.
To indicate flow failure, reduction in flow to calibrated value or indicating delivery blockage. Standard model size ¼" B.S.P.—½" B.S.P. Other models in sizes up to 14".

VHPS High Pressure Switch. Fully adjustable, piston operated. Pressure range up to 10,000 p.s.i.

DPS MKIV Differential Pressure Switch. Stainless steel construction speciallydesigned for Nuclear Power Stations. High static, high temperature. Medium CO_2. Pressure 300 p.s.i. Temperature 250°C.

BA1

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Announcing the

DRAWING OFFICE EQUIPMENT

A SPECIALISED EXHIBITION

. . . where manufacturers of equipment and materials specifically produced for use in all types of drawing offices—industrial, research, educational, professional, national and municipal government—will be exhibiting their latest products for the benefit of executives.

The buyer can inspect the latest equipment and materials—most of which will be in actual production, fully tested and readily available—shown by nearly sixty specialised companies grouped under one roof on this scale for the first time.

JUNE
5, 6, 7, 8
1961

At existing industrial exhibitions only a very small proportion of the available space can be spared for the manufacturers and suppliers of drawing office equipment and materials. The visitor is, therefore, unavoidably denied the benefit of seeing a truly representative selection of these important items.

Now, for the first time, virtually every drawing office requirement will be available for you to make side-by-side comparisons of design, price, quality and value. Much of the equipment shown will be operational so that examination of actual results can help you in your selection.

You cannot afford to miss this

ENND MATERIALS EXHIBITION

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SOCIETY'S NEW HALL
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Note the dates in your diary NOW!

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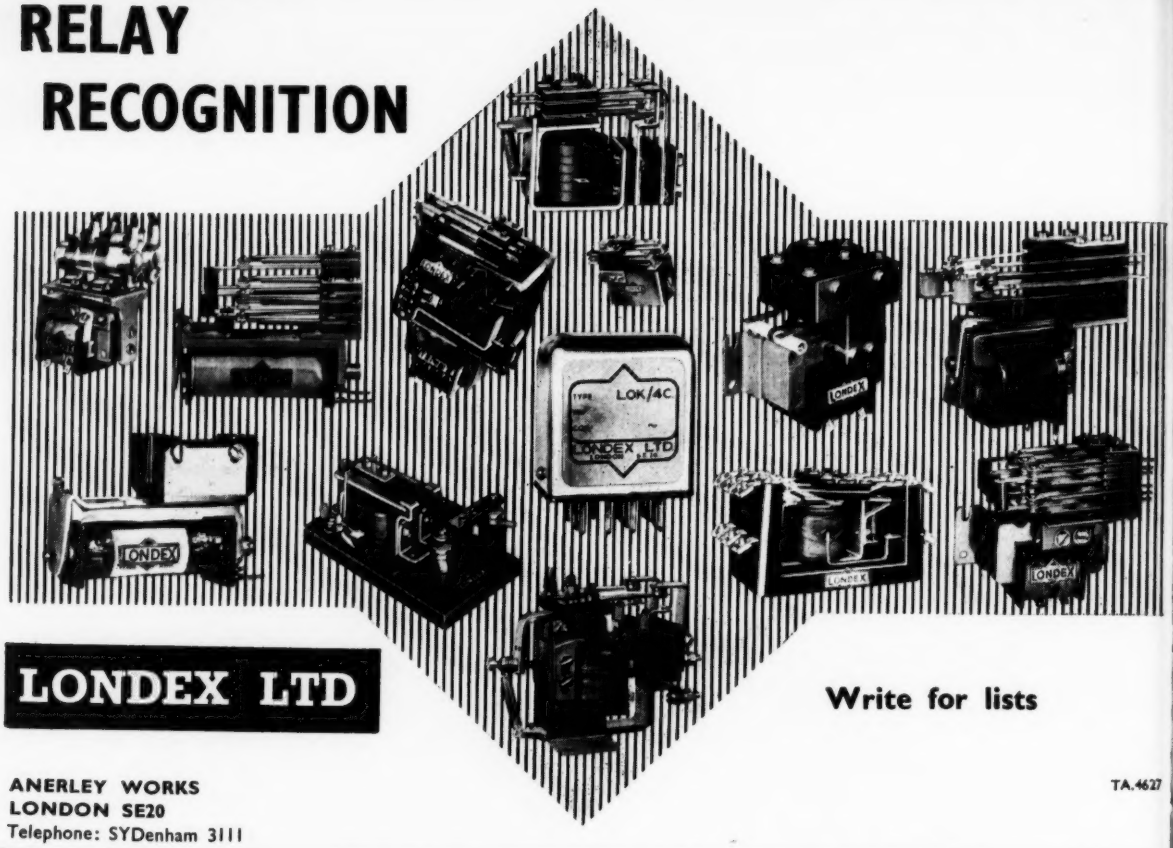

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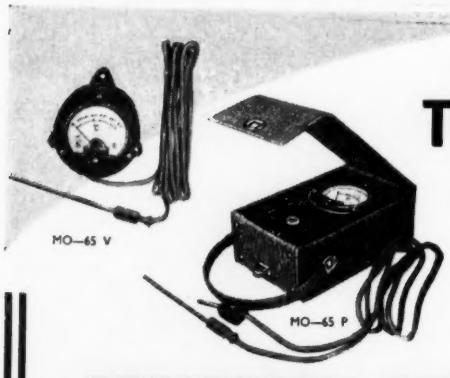


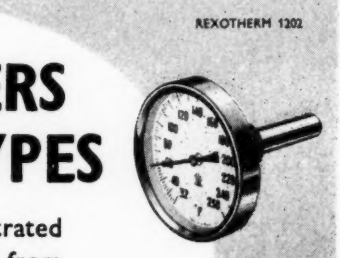
THERMOMETERS OF ALL TYPES

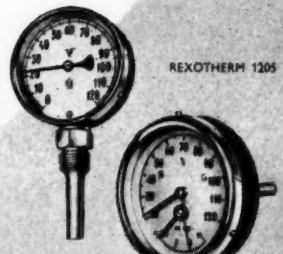
The instruments illustrated here are just a few from the famous

REXOTHERM BIMETAL RANGE

Many other types available from stock.

If you want good thermometers at reasonable prices, please write for Industrial Instrument List to





CHARLES ELEY & SONS

20 & 30 NOTTING HILL GATE
LONDON, W.11 BAYswater 7474 & 1088

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specify H point contact germanium diodes

Hughes HG10 series are point contact germanium diodes with high peak inverse voltage, high back resistance and good forward characteristics. They have excellent recovery characteristics and evidence no forward current saturation within their power limitations.

Made in Glenrothes, Scotland, the Hughes range of silicon and germanium diodes are subminiature devices with extremely stable electrical and mechanical characteristics. These diodes are specially designed and constructed to meet the most exacting requirements of military or commercial applications. They are double wire ended and fusion-sealed in a subminiature one-piece glass envelope to ensure complete isolation of the active elements from damage or contamination. The small size, combined with rigidity of construction and small mass of the elements, enable them to successfully withstand physical shock and vibration.

Type No.	Continuous Ratings 25°C		Characteristics @ 25°C	
	Peak Inverse Volts	Max. Forward Current	Min. Forward Current at 1V	Max. Reverse Current at 50V
HG1001	100	45 mA	20 mA	50 μa
HG1002	100	45 mA	20 mA	100 μa
HG1003	100	45 mA	10 mA	50 μa
HG1004	100	45 mA	10 mA	100 μa
HG1005	100	45 mA	5 mA	50 μa
HG1006	100	45 mA	5 mA	100 μa
HG1007	75	45 mA	20 mA	50 μa
HG1008	75	45 mA	20 mA	100 μa
HG1009	75	45 mA	10 mA	50 μa
HG1010	75	45 mA	10 mA	100 μa
HG1011	75	45 mA	5 mA	50 μa
HG1012	75	45 mA	5 mA	100 μa

1:1 Actual Size

Qualified engineers in our Research and Development laboratories at Glenrothes are available to help with your application problems.

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HUGHES INTERNATIONAL (U.K.) LTD.
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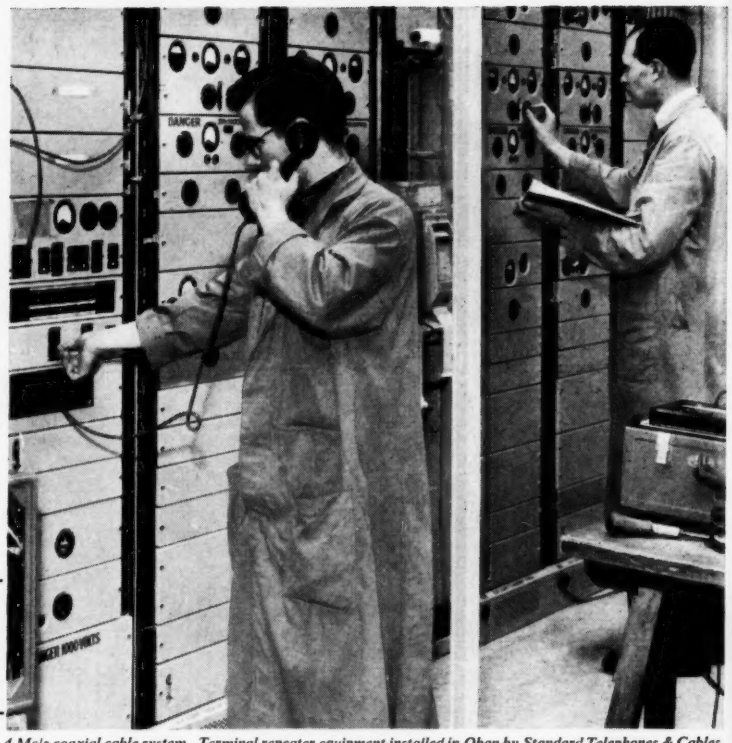
IT COSTS NO MORE TO BUY THE BEST

Specify WESTON on your equipment

The demand created by the high quality of Weston meters is such that production techniques can be employed which enable these outstanding instruments to be produced at competitive prices.

There can be no finer advertisement for your equipment than the name "Weston" on the meters installed



4 Mc/s coaxial cable system. Terminal repeater equipment installed in Oban by Standard Telephones & Cables Ltd — part of the transatlantic telephone link.

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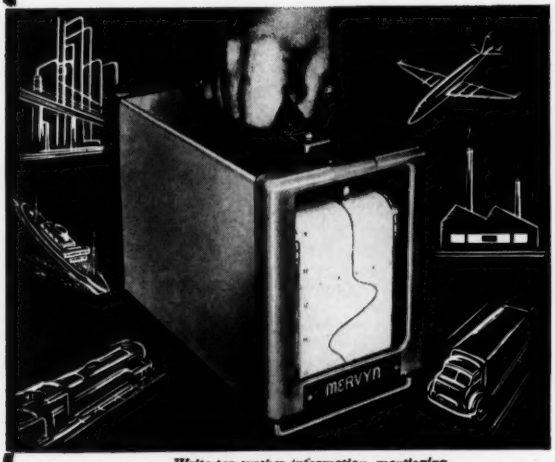

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WOKING · SURREY · ENGLAND

Tel: Woking 5200-3

THE COMPLETELY BATTERY-OPERATED PORTABLE POTENTIOMETER RECORDER

Miniaturisation par Excellence!

For sheer versatility, there is nothing to approach this new MERVYN instrument . . . its uses are legion both in the factory and in the field. It is the *only* Potentiometer Recorder that is both portable and self-contained—weighing just 17 lbs., complete with its own INTERNAL DRY BATTERY POWER SUPPLY.

- Internal Battery Power Supply has a life of 250 hours
- Low Drift Transistor Chopper operating at a frequency chosen to minimise 50-cycle interference
- Battery-driven motor for the combined Potentiometer and Writing Drive
- Transistorised amplifier and voltage reference from Zener Diode
- Inkless Recording using 7-day clock mechanism

The ranges acceptable are from 0-5 mV up to 0-1 volt, by Interchangeable Range Cards

MERVYN INSTRUMENTS

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Circle **162** for further information

now available to British Industry

CHLOROTHENE NU

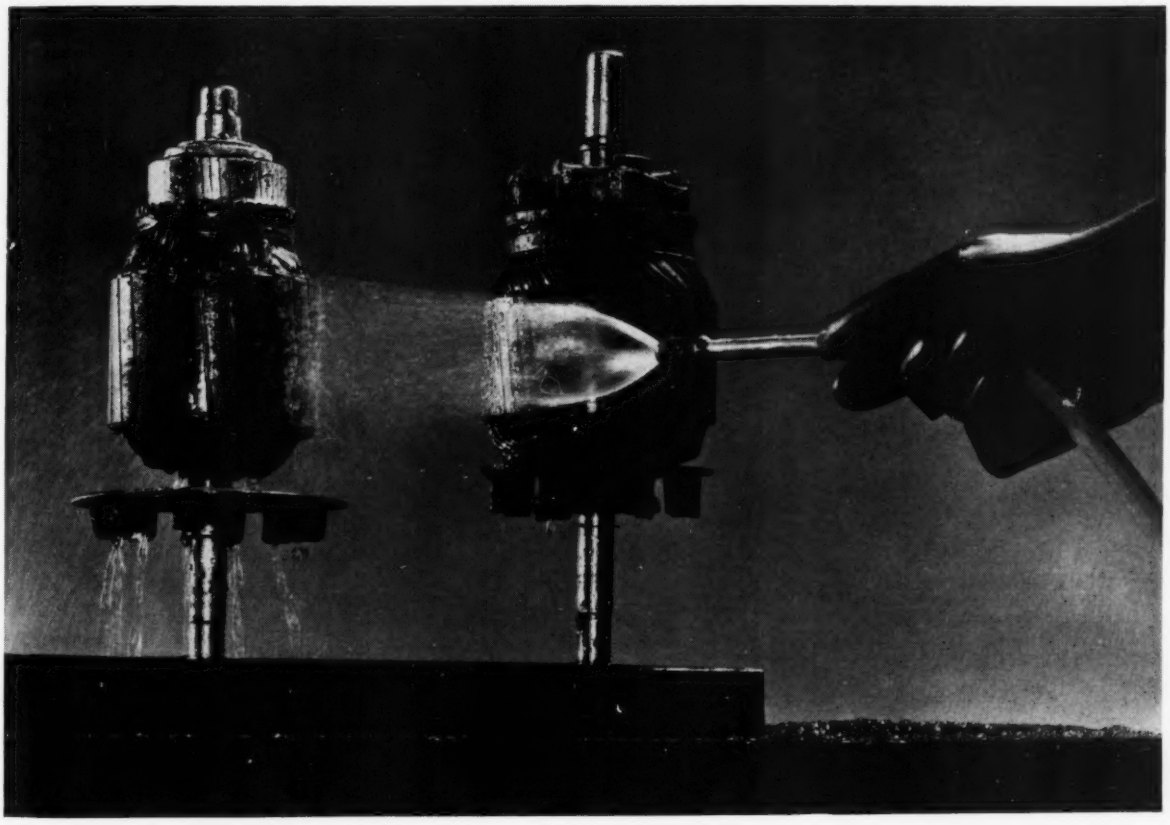
COLD CLEANS ELECTRICAL EQUIPMENT WITHOUT CORROSION

Safe, superior Chlorothene* NU, now revolutionizing cold cleaning operations in the U.S. electrical industry, eliminates corrosion of sensitive metals *and* insulation materials. Its exceptional stability (specially inhibited 1,1,1-trichloroethane) makes it ideal for cleaning even aluminium, zinc and white metal alloys, as well as plastics, rubbers and other materials. In fact, Chlorothene NU cleans everything from electric circuits to complex electronic brains. It has successfully cleaned finishes to which ultrasonics have proved injurious.

Safe in two ways! Chlorothene NU greatly reduces the twin hazards of toxicity and fire. Its maximum allowable vapour concentration is 500 parts per million—comparable with many flammable solvents and substantially higher than most chlorinated solvents. Chlorothene NU practically eliminates the fire risks of flammable solvents because it has *no fire or flash point!*

Chlorothene NU cleans by dip, spray, slush or wipe methods —on the production line or for maintenance. It quickly removes greases, oils, waxes, tars and other soils, and dries fast without leaving a residue. For complete information about its specific advantages in the cleaning of electrical equipment, contact the distributor *NOW*.

**Trademark of The Dow Chemical Company, U.S.A.*



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TEXTILE FIBRES
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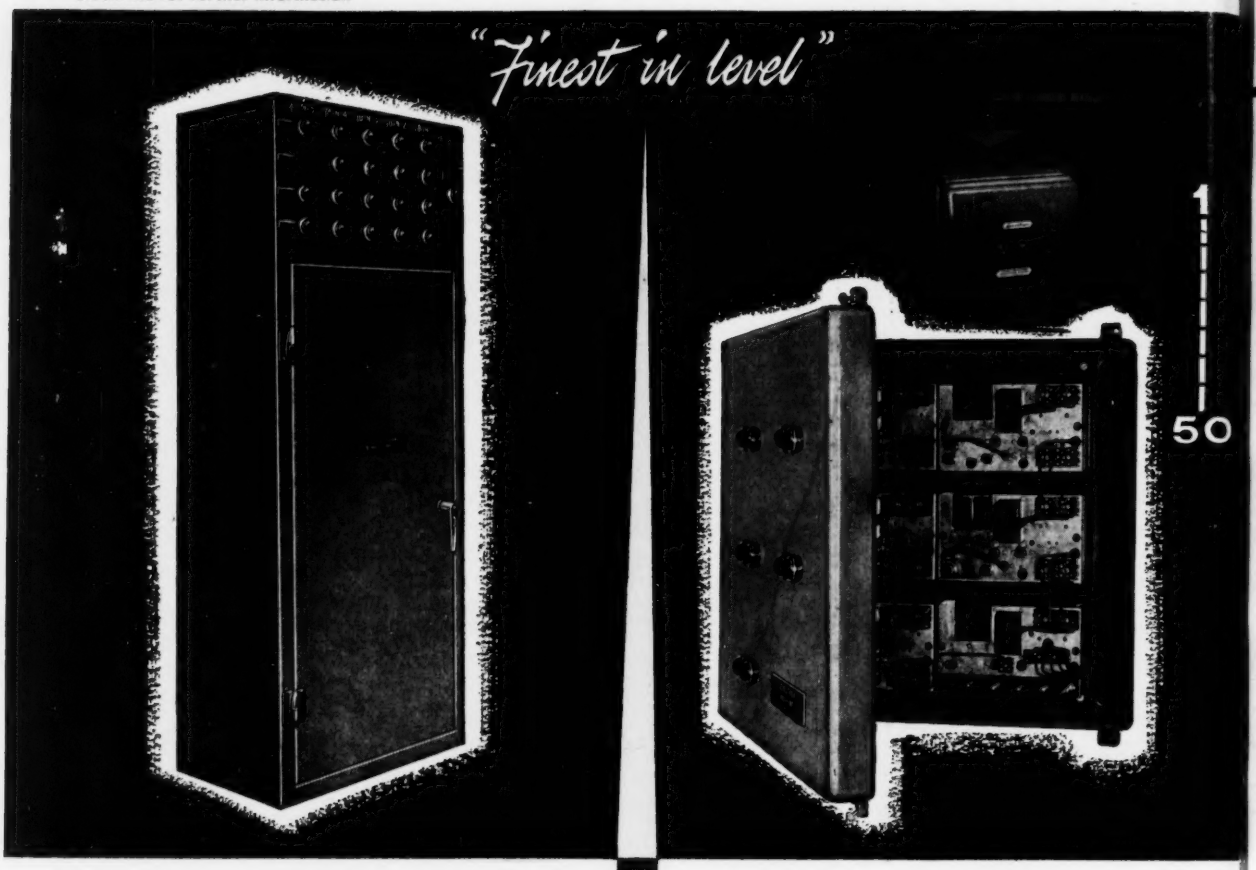


The LEVELTRON Console

A MULTIPOINT AUTOMATIC CONTROLLER

A specially designed automatic bin controller has been developed to cover the automatic filling and emptying of bins, tanks and silos. This automatic controller is designed to cover up to six bins, giving control of motorised or solenoid operated valves for filling and emptying controlling feed conveyors and elevators, etc., in sequence.

A team of highly skilled industrial electronic engineers manufacture and assemble this important automatic level controller. Only the finest components and materials available are used.

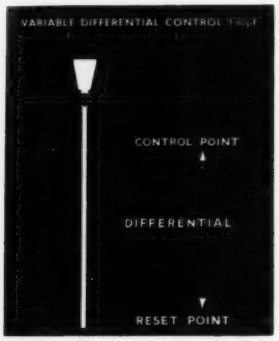
Simplicity of design and surface wiring enables easy maintenance.

A weatherproof, dustproof console houses the famous Leveltron industrial controllers together with all ancillary equipment. A neatly designed indicating panel is incorporated giving easy visual indication.

The centralisation of level control and indication has simplified the use of this equipment on plant and has also saved considerably on installation costs. Already the use of this new automatic bin controller has increased efficiency in production and has saved considerable man hours. *Patents Pending*

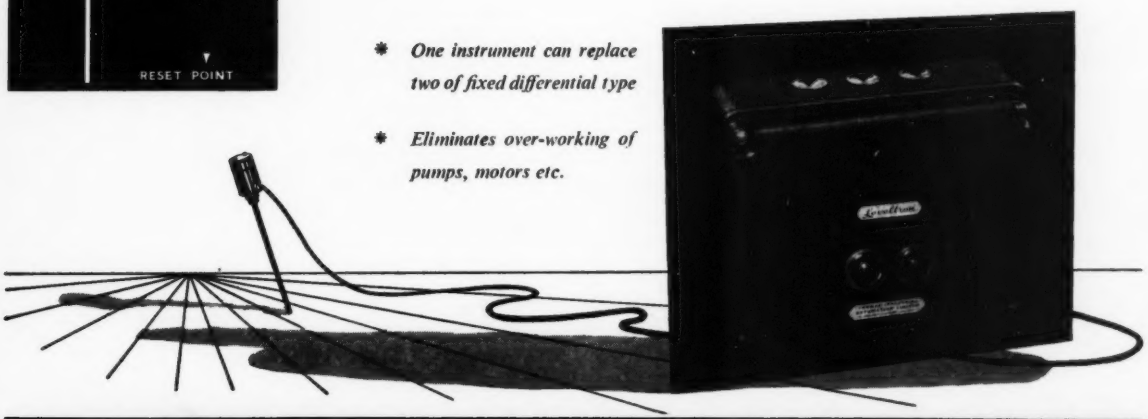
LEVELTRON

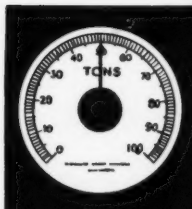
for CENTRALISED LEVEL CONTROL



Sets new standard of sensitivity, stability and reliability in level detection of flour, meals, grain, wheat etc., and all liquids. Stability within 0.5 pf. maintained over long periods. Special Duty Electrode systems eliminate worries of 'build-up.' Can detect level changes with remote electrode systems up to 500 feet from controller with *no electronics in electrode head or on container*. Standard cable lengths up to 35 feet. Specially designed dust and weatherproof cast iron case. 'Fail to Safe' high or low level on standard instruments.

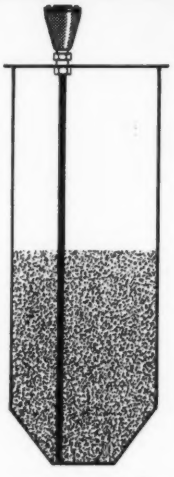
- *One instrument can replace two of fixed differential type*
- *Eliminates over-working of pumps, motors etc.*





The LEVOLOG REG°

CONTINUOUS LEVEL INDICATOR



This capacitance operated instrument is used with a vertically mounted Electrode system in containers of all types up to 60 ft. in depth. Can be used with flour, powders, free-flowing solids and liquids. Local indication provided, remote indication any distance from controller. *Sets new standard in continuous level indication.* Independent of mains and temperature variations. Near linear scales which are calibrated to customers' requirements. Control unit housed in dust and weather-proof Cast Iron Case.

MULTIPOINT UNIT from **5 to 50** points for centralisation.

SIMPLE to operate. SIMPLE to instal. Write for details.

"Finest in level"

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What . . . me take CO_2 test readings?

It may not be everyone's line of work . . . but anyone *can* take accurate readings with Gordon's MONO Portable Tester. Dial reading makes $\%CO_2$ crystal clear — simpler and surer to read than liquid column gauges. This light, leak-proof portable can be carried anywhere ready for use. Send for technical literature.

For any aspect of instrumentation and control for steam boilers, turbines, consult :

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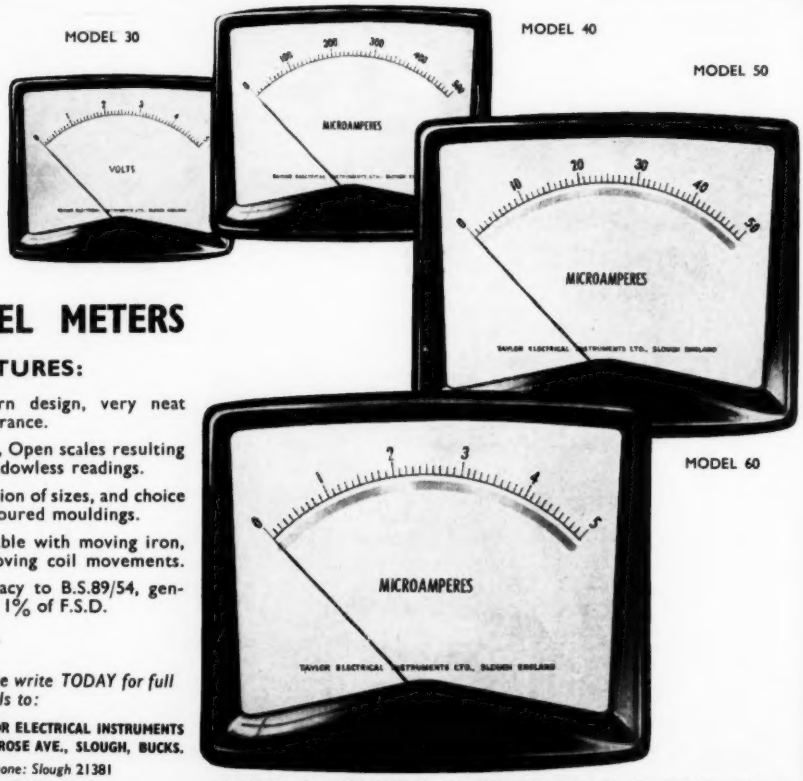
NEW Vista



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OUTSTANDING FEATURES:

- ★ Centre pole movement. High Torque to Weight Ratio.
- ★ Extreme Robustnessh (Sock-proof jewels).
- ★ Very high sensitivities commencing from 5 Microamps.
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- ★ Competitive prices.

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measurement
by
projection
with

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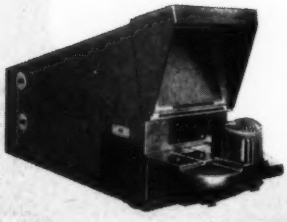

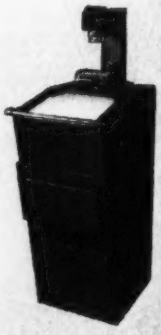

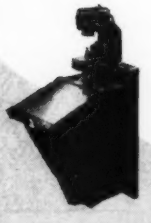

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Simple projectors for checking form and dimensions of small components against enlarged layouts. Thread forms can also be checked against templates. Magnifications from X 10 to X 500.

Production Projectors

Similar to Inspection Enlargers, but designed for use in the horizontal position so that the operator can be seated for rapid checking, without fatigue, of mass-produced components.

Universal Projectors

Combine the advantages of ordinary projection with the addition of micrometer measuring equipment reading to 0·0001 in. Co-ordinate measurements to 0·0001 in. and angular measurements to 1 minute can be made. Largest instrument will accommodate work up to 50 lbs. in weight, projector screen being 20 in. dia. and measuring range 7 in. horizontally and 2¼ in. vertically.

Send for illustrated catalogue "Hilger Projectors for Production."

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AD.425

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JLT instruments for Industry

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TRANSISTORISED A.C. VOLTAGE REGULATOR

MODEL T200

Exceptional reliability coupled with precision performance. Combination of semi-conductor and magnetic design techniques gives fast response time. Suitable for incorporation in larger equipments where reliability and long service are of prime importance.

Output regulation: ± 0·25% for ± 10% change in input voltage.

Distortion: less than 3%.

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INSTRUMENT PRACTICE

CONTROL SYSTEMS-ELECTRONICS-AUTOMATION

Editor: J. T. Miller, B.Sc., F.Inst.P.

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VOL. 15. No. 1

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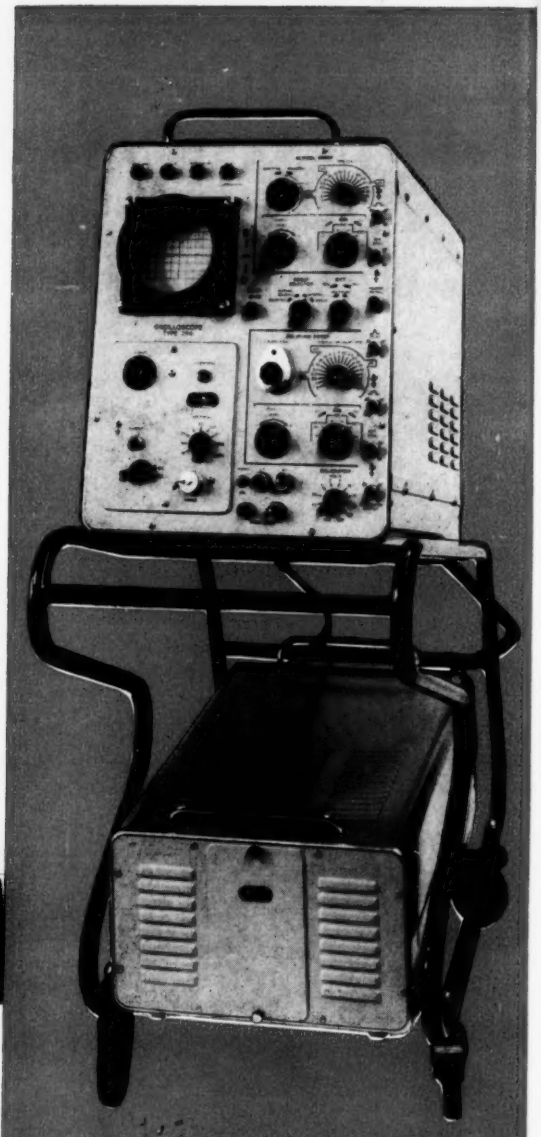

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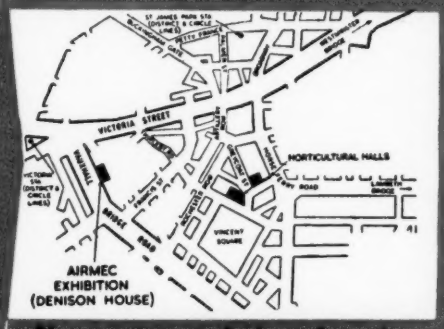

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INSTRUMENT PRACTICE

COMMENTARY

Electronic Switching—Instrumentation in Telephony

From the time of its introduction in this country to just after the first world war, telephone exchanges, with one or two isolated exceptions, were operated manually. An operator, forming a manual switching link, completed the necessary connections between two subscribers. It was inevitable that the thoughts of telephone system development engineers should be directed towards the possibility of performing the switching operation automatically. A number of methods were developed of which the Stowger system, adopted in this country, was noteworthy. Here, the subscriber dialled a set of pulses equivalent to the number required and the switching sequence was carried out by electromechanical rotary switches and switches with a rotary and vertical motion. This pattern of telephone exchange, a very early example of automation, has given excellent service, but with the application of solid state devices such as diodes and transistors as switching means in computers and data processing systems, attention was directed towards the use of these devices in automatic telephone exchanges. Development of what is essentially a new electronic automation system has been in the care of the Joint Electronic Research Committee, a liaison group involving the General Post Office and five manufacturers. The latter comprise Associated Electrical Industries Ltd., the Automatic Telephone and Electric Co. Ltd., Ericssons Telephones Ltd., The General Electric Co. Ltd. and Standard Telephones and Cables Ltd. Development has proceeded to the extent that a model of a proposed electronic telephone system is operating at the Dollis Hill research station of the General Post Office and an actual exchange, Highgate Wood, is being completed.

One obvious question will be asked. Why adopt the new techniques if the existing ones are working well? Two of the main reasons are that it is hoped to reduce the cost and the bulk of automatic telephone exchanges. In addition, it is aimed to improve reliability and provide greater flexibility.

To record development in solid state switching for automatic telephone exchanges, the Institution of Electrical Engineers recently held a conference on Electronic Telephone Exchanges. Papers were given by engineers from member concerns of the Joint Electronic Research Committee and from companies in the United States and on the Continent.

The systems described in the papers fall broadly into two classifications: the space division and time division. In space division the speech circuits are physically distinct and the frequency band associated with each channel coincides with the speech band. In time division one physical channel is used, and several subscribers are given access to the channel in a cyclic manner in rapid succession so that a corresponding number of conversations can proceed simultaneously. Such a system is given the designation t.d.m. or time division multiplex, and it has been adopted for Highgate Wood which involves 100 channel 4-wire transmission circuits. Each channel must include an amplifier, but the arrangement requires a minimum number of connector switches.

Switching devices must have a high impedance in the "off" condition, a low impedance in the "on" condition, low noise and distortion, low power consumption in the "on" condition and low cost. Three devices have received attention in this connection, the cold cathode gas-filled valve, the reed pattern hermetically-sealed relay and more recently the p-n-p-n diode.

To control the setting-up of a connection through the exchange it is necessary to store information relating to the subscriber's line or a junction. For this purpose a magnetic drum is used at Highgate Wood. Each track accommodates 100 words of 28 bits each. Regarding the exchange as being divided into sub-groups of 100 lines, one track caters for information associated with one sub-group.

Ancillary circuits include connection stores, supervisory units, register units and the translator. The broad application of data processing techniques can be seen not only in this exchange but in others developed abroad.

The situation is extremely fluid at the moment. No one country has much operating experience with the electronic exchange. New and improved components and materials are being developed continuously, and, as can be seen, the component is a key member of the system. Finalising may be difficult, therefore, for some time, although an influential factor here may be foreign competition. The electronic telephone exchange, however, is a logical development in switching instrumentation and respresents as big a stride from electromechanical devices as the latter were from manual operation.

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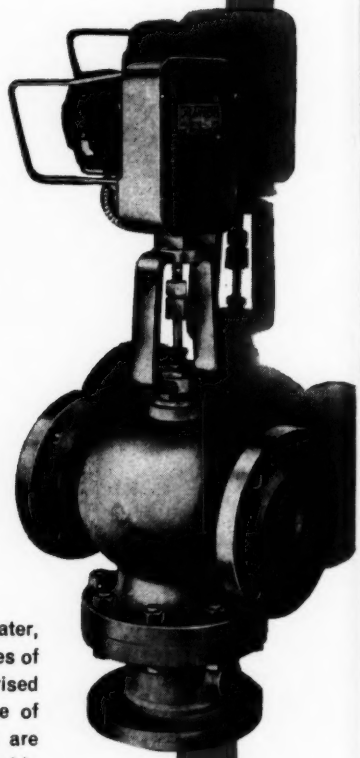

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Summary

A simple and accurate optical liquid level detector, which is operated by the change in refractive index of a suitable surface when immersed in a liquid, is described.

A timing unit for a volumetric calibrating tank based on the liquid level detector has been constructed and complete details are given of the liquid level detector and gate units.

Preliminary tests suggest a normal working accuracy of the order of 0·010 in. for level detection.

A Liquid Level Detector and Timer for use with a Volumetric Calibrating Tank

By J. J. HUNTER*

1. Introduction

ACCURATE measurement of flow is essential for accurate measurement of the performance of hydraulic machinery. Volumetric flow measurements can be made by diverting liquid into a measuring tank and, if the flow rate is steady, the time taken for the liquid to pass between two given levels, marking a known volume of the tank, gives the flow rate.

Equipment for this time measurement has been developed and is used in conjunction with a pipette shaped 20 gal tank in which two liquid level detectors are fitted. Oil is admitted to the base of the pipette and, on reaching the lower detector, starts a counting timer: on reaching the upper detector the timer is stopped (*see* Fig. 1).

An accuracy of 0·1% has been aimed for in the design of the calibrating tank, and this requires an accuracy of 0·060 in. in liquid level measurement. An optical liquid level detector, accurate to 0·010 in., has been devised, which avoids the difficulties associated with earlier optical systems, and allows a simpler measuring circuit to be employed than with other types of level detectors of similar accuracy.

Only the liquid level detector and gate units will be described further as the frequency standard and counter units are conventional.

2. Liquid Level Detector

In this application, where only clean liquids are being used, an optical system appeared attractive.

There are two ways of making the presence of a liquid actuate a photocell. That which is most common depends on attenuation of a light beam by the liquid entering its path, and the other makes use of the change in refractive index when a transparent surface is covered by oil, to divert the light beam from the photocell.

In the first case the use of semi-transparent oils of varying densities would give rise to small and differing signals. In the second the light is either "on" or "off". Consideration of the latter suggested that a neat solution[1] would be to use the change in critical angle when a suitable surface was immersed in liquid to allow the light to "leak" out of a light guide; Perspex was used for this purpose. The critical angle for Perspex

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to air is approximately 42°, to water about 55°, and even greater than this for the oils used, which have a refractive index close to that of Perspex. In the light guide shown in Fig. 2 the Perspex surfaces are angled so that the light beam strikes them at an angle of 45°. When the outer surface is exposed to air the angle of incidence is greater than the critical angle so the light is internally reflected around the light guide, and falls on the phototransistor. When the operating surfaces are immersed in liquid the incident angle is less than the critical angle so the light passes out of the light guide into the liquid.

3. Liquid Level Gate Unit

Signals from the level detector units are used to "gate" pulses of standard repetition rate obtained, in the Hydraulic Machinery building of N.E.L., from a distribution system[2]. The signal from the lower detector unit opens the gate circuit, while that from the upper detector unit closes it (Fig. 1). This mainly determines the circuits required as will be seen when the pulse gate circuits are considered. The unit will also accept a negative input pulse from 1 V upwards and produce a standard 4 V negative output pulse. The "gated" standard pulses are accumulated in a counter and give the time taken by the oil to pass between the two reference levels.

The signal gating and shaping circuits, which will be dealt with first, are illustrated by simplified diagrams (Figs. 3, 5, 8 and 9) and the actual circuits are shown interconnected in Fig. 10.

3.1 *Pulse Limiter*

The standard repetition rate pulses available from the distribution system vary in amplitude from 1·5 to 2 V.

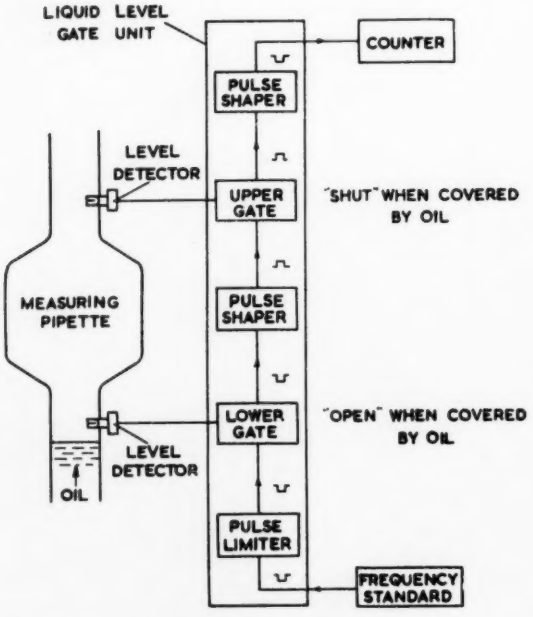


Fig. 1. Block diagram of flow calibration rig

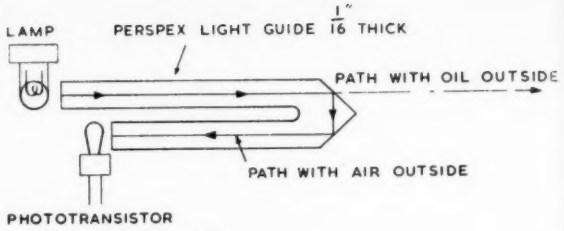


Fig. 2. Light guide

To produce pulses of fixed 2 V amplitude suitable for the gate input, these pulses are stepped up in voltage by a transformer (Fig. 3), and subsequently limited to a fixed voltage by the voltage reference diode in the emitter circuit of the emitter follower and 2 V pulses are obtained from the potential divider. The diode shown in the base circuit, which eliminates stray positive pulses and transformer overshoot, could be replaced by a suitable voltage reference diode and perform the function of both diodes. However, the only voltage reference diodes available at the time of construction imposed too heavy a capacitive load on the transformer secondary circuit for this to be done.

3.2 *Level Detector Unit*

The detector units (Fig. 4) each contain a light source, a light guide similar to that shown in Fig. 2, a phototransistor, a second transistor which is used for temperature compensation and forms part of the pulse gate circuit. There is also a test lamp mounted behind the phototransistor. The test lamp illuminates the phototransistor through an adjustable aperture which can be set to give the same signal as is given by light from the light guide. With the phototransistor base open circuited a signal in the order of 1 mA is produced when it is illuminated. Phototransistors having the highest sensitivity among a batch of six were used in the level detectors.

A light guide surface parallel to the liquid surface could have been arranged to make the detector operate for a negligibly small change in liquid level. As this arrangement could be upset by drops of liquid hanging on to the surface it was not adopted, and instead the outer faces of the light guide were made part of a plane surface (Fig. 4), perpendicular to the direction of liquid flow. This means that the liquid must move by the thickness of the light guide to allow all the light to "leak" out of the light guide. However, due to the small size of the phototransistor, a light guide thickness of 0·0625 in. produces an adequate signal and subsequent circuits sharpen the resolution of level detection to give a working accuracy of about 0·010 in.

3.3 *Pulse Gate Circuit*

The light signal causes a current flow in the order of 1 mA in the phototransistor. However, the temperature dependent dark current of the phototransistor may vary from 300 μA at 25°C to 1·5 mA at 40°C. An effective method of temperature compensation is obtained by connecting a similar transistor in a balanced gate circuit. This compensating transistor is placed in a blind hole close to the phototransistor. The collector resistor

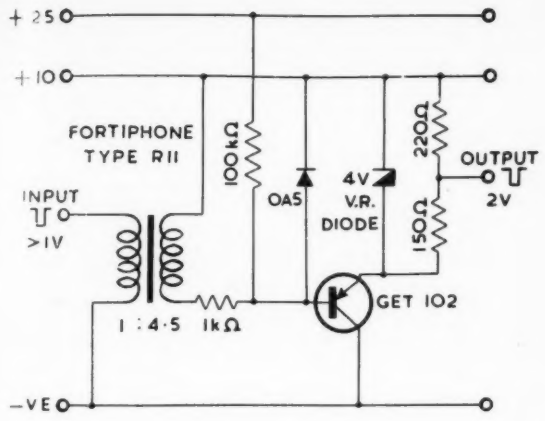


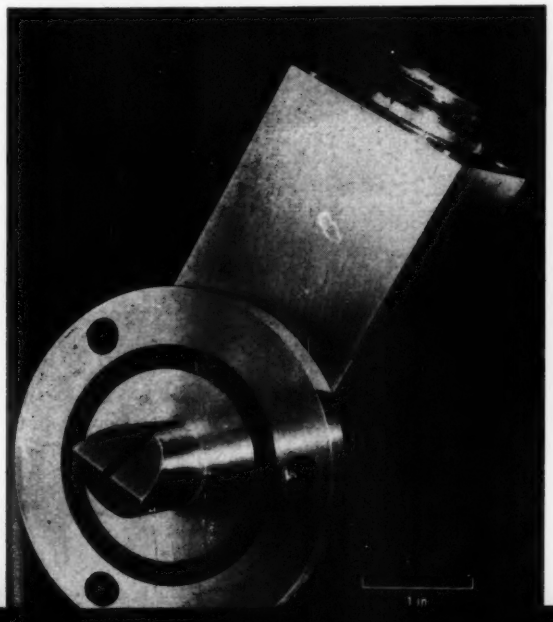
Fig. 3. *Pulse limiter circuit*

of the compensating transistor is adjusted until the voltage drop across it is equal to that across the collector resistor of the phototransistor due to its dark current.

This adjustment is made at the front panel (Fig. 6a) using the meter switched to positions 2 or 4 for the lower and upper gate circuits respectively, until the initial response and subsequent small drift on switching off the lamp are both below zero on the meter. This is necessary as the phototransistor temperature, and hence dark current, change slightly with operating point.

The photo-current produces a signal of about 5 V in the phototransistor collector resistor and this is used as the switching voltage for a simple transistor pulse gate circuit (Fig. **5**). In this circuit the common emitter resistor is held "on" at a voltage set by whichever base voltage is more negative of the gate transistors. The base voltages are equal with no light on the phototransistor. When the phototransistor is illuminated,

Fig. 4 (*a*). *Level detector unit*



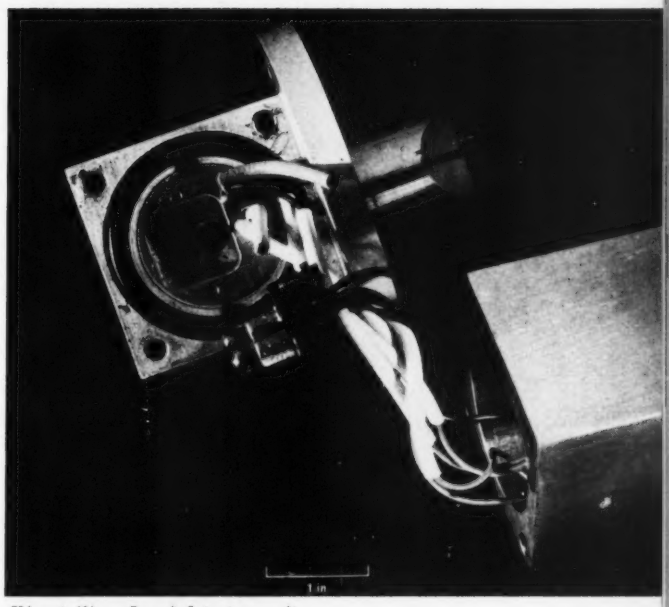


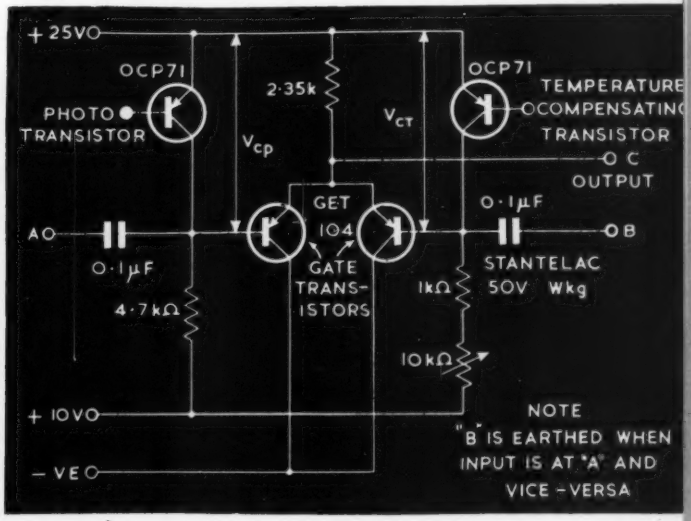
Fig. 4 (*b*). *Level detector unit*

the base of the gate transistor to which it is connected goes 5 V more positive and is cut off.

The function of the lower and upper gates is different as the light going "off" must open the lower gate while the light going "off" must close the upper gate. Fig. 7 shows that a negative pulse input at A is required for the lower gate while a positive pulse input at B is required for the upper gate.

The sequence is then (Fig. 10)—with the lower gate phototransistor T_2 illuminated, T_3 is cut off and the 2 V negative input pulses do not reach the cut-off voltage and so produce no output. When the oil reaches the lower detector the light goes off its phototransistor T_2,

Fig. 5. *Pulse gate circuit*



the base voltage of T_3 becomes equal to that of T_5 and the input pulses can now bring T_3 into conduction, thus producing an output pulse.

This negative output pulse must be inverted for input to the upper gate. The first pulse shaper does this and, in addition, eliminates the effects of drift in the gate circuit by using only the range from 1 to 1·2 V of the 2 V negative pulse. This also serves to sharpen the resolution of the level detector.

While the liquid is below the upper level detector, T_{10} is illuminated and conducting, cutting off T_{11}. The gate emitter voltage is set by T_9, and can go positive when 2 V positive pulses from the first pulse shaper appear at the base of T_9. When the liquid reaches the upper level detector, T_{10} is turned off, the base voltage of T_{11} becomes more negative to equal that of T_9 and hold the gate emitter voltage so that no output is produced.

The 2 V positive pulse output from the upper gate, when both gates are open, is inverted by a second pulse shaper which supplies a 4 V negative pulse to the output socket.

The base capacitor of the reference gate transistor is earthed in each gate unit to keep its impedance low for the input pulses. The base circuit time constant so formed is, however, short compared with the speed at which the liquid level changes so that no appreciable time lag is introduced.

3.4 *Pulse Shaper*

The operation of only the first pulse shaper (Fig. 8) will be described as the second pulse shaper (Fig. 9) is its exact inverse with the exception that it produces 4 V instead of 2 V output pulses.

The input transistor (Fig. 8) is cut off by the 1 V bias on its emitter chain and does not conduct until the input pulses exceed this bias. The voltage gain of this stage is approximately 20 so that the collector swings 4 V for the next 0·2 V of the input pulse. The collector voltage swing is held at 4 V by the voltage reference diode which, besides determining the amplitude of the output pulse, prevents the transistor from saturating and so upsetting the input time constant. The input time constant is long enough for the input pulse to determine the output pulse width. The collector resistor is arranged as a potential divider supplying a 2 V pulse to the complementary transistor emitter follower which provides a low impedance output. The use of complementary transistors, in this case, is advantageous as both transistors are off, so drawing negligible current from the supply for most of the time, and if necessary the output transistor can supply a large output current.

3.5 *Lamp Current Stabilised Supply*

The lamps used require 100 mA at 12 V, and to keep the light output constant the current is stabilised. The

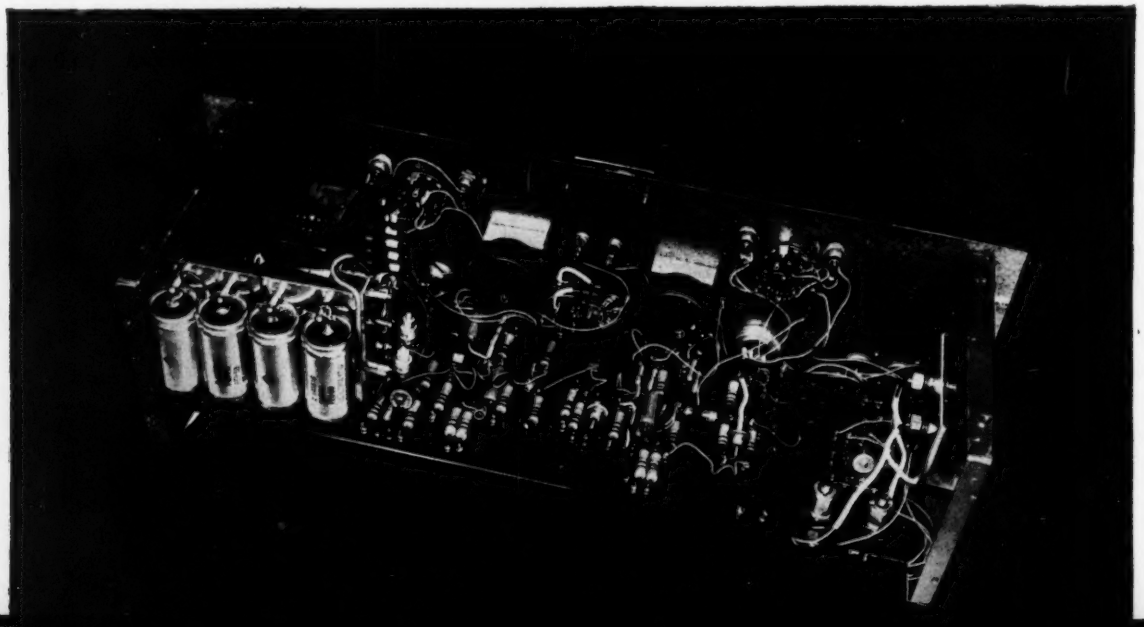


PHOTO TRANSISTOR	INPUT A	INPUT B	OUTPUT C	GATE UPPER	GATE LOWER	
ILLUMINATED	⊓				CLOSED	*
	⊔					
V_{cp} + ve W.R.T. V_{CT}		⊓	⊓			
		⊔	⊔	OPEN		*
DARK	⊓		⊓		OPEN	*
	⊔					
$V_{cp} = V_{CT}$		⊓	⊓			
		⊔		CLOSED		*

THE ONLY UNIQUE COMBINATIONS FOR UPPER AND LOWER GATES ARE SHOWN *

Fig. 7. *Possible pulse inputs to gate circuit*

lamps form the collector load of a power transistor (Fig. 11). The collector current of this transistor is set by its emitter following its base potential which is determined by the voltage reference diode, fed by a smoothed current, in the base circuit. As the emitter voltage is close to the base voltage, the emitter current, and hence collector current, depend on the emitter resistance. The emitter resistor is variable to accommodate differences in voltage reference diodes, lamps and phototransistors.

The light source and test lamps in the detector are in series with lamps marked "use" and "test", respectively, on the front panel so that lamp failure will be immediately apparent. A voltage dropping resistor is substituted for the lamps in the "off" position of the lamp selector switch, to ensure that the power dissipation of the transistor is kept low.

3.6 *Meter Circuit*

The meter (Fig. 12) is provided for zero adjustment of the compensating transistor collector resistor. For this adjustment the meter is connected between the separated emitter resistors of the gate transistors. These resistors are joined to form a common emitter resistor in the "use" position of the meter switch. The meter reads 10 V full-scale so that it can also be used for observing the light signal voltage.

In positions 1 and 5 for the lower and upper gates respectively, the meter indicates the current in the phototransistor.

3.7 *Power Supply* (*Fig.* 13)

The phototransistor supply voltage required is determined by the light signal voltage plus the voltage due to dark current which has to be accommodated over the ambient temperature range. With a light signal of 5 V, a 15 V supply permits 2 mA of dark current before the light signal voltage becomes limited. From the makers' data this corresponds to a minimum temperature of 42°C, whereas, for other reasons (*see* Section 4.1), the maximum working ambient temperature is 35°C. As the transistor photo-current, and the other circuits fed from this supply, are relatively unaffected by voltage variations the +25 V line is not stabilised.

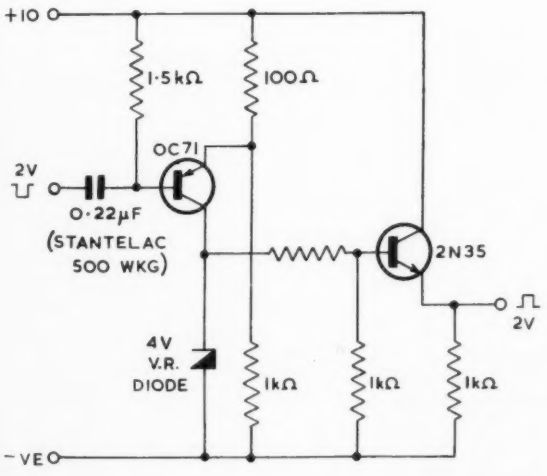


Fig. 8. 1*st pulse shaping circuit*

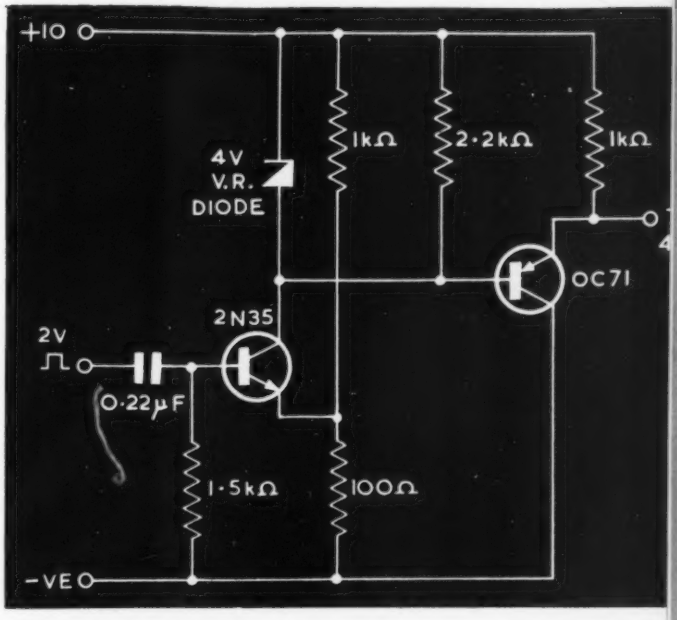
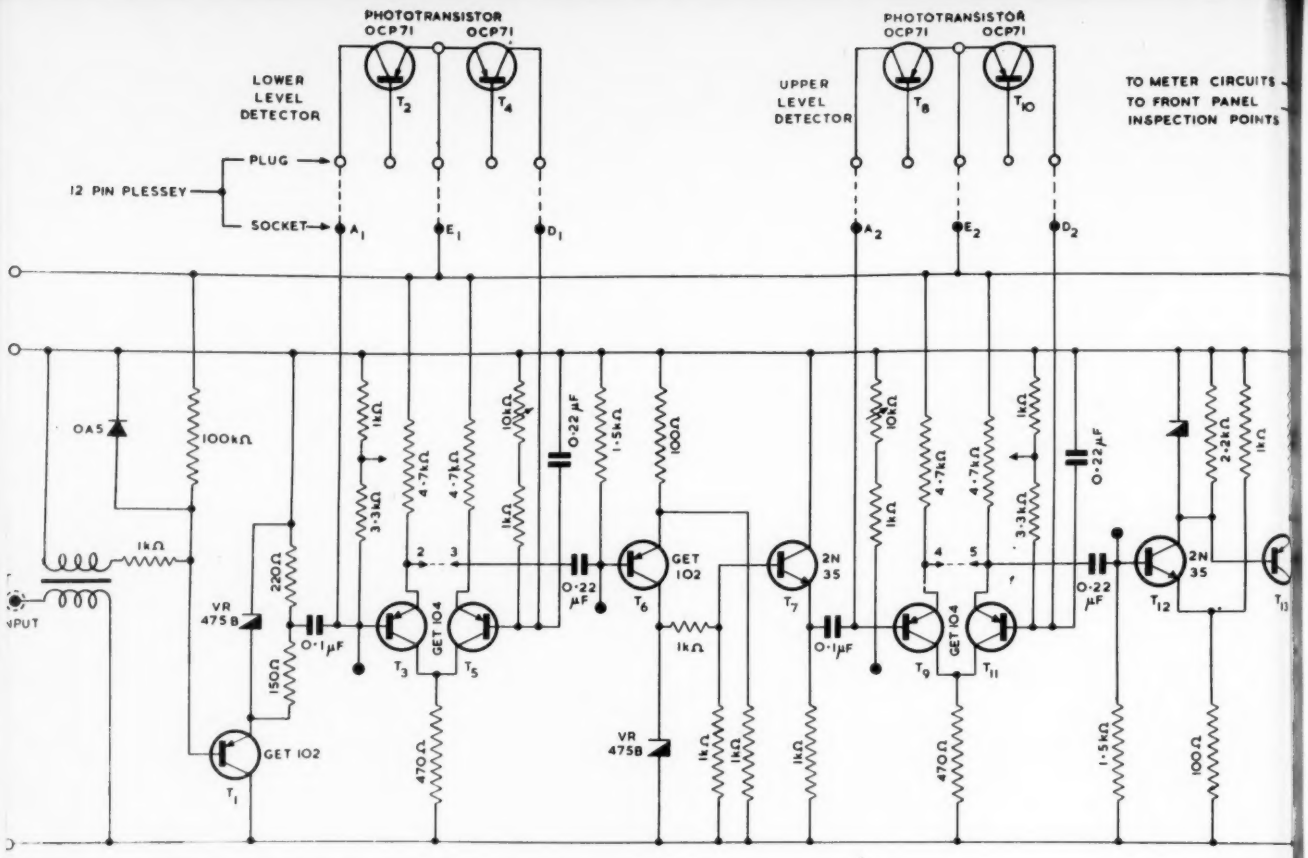


Fig. 9. 2*nd pulse shaping circuit*

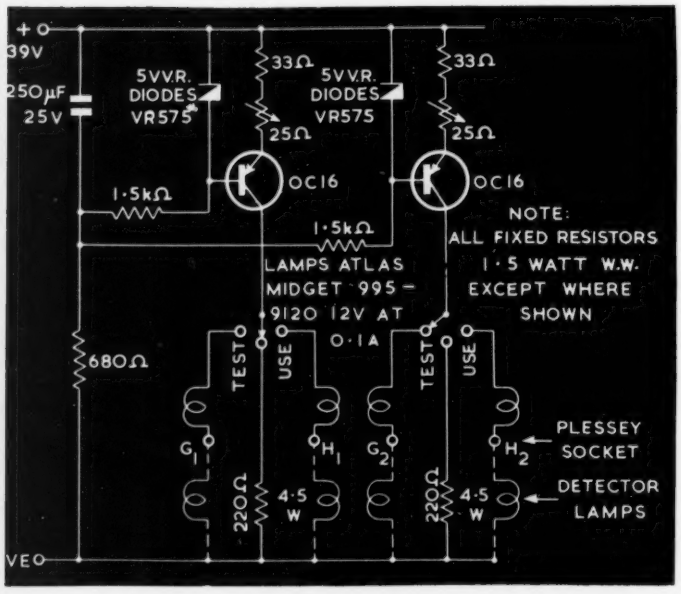
A stable 10 V supply which is required for the pulse shaper circuits is taken from the voltage reference diodes. This also supplies the input pulse limiter circuit, and the collector of the gate transistors which must be more negative than the collectors of the phototransistors.

The supply negative is earthed since lamp sockets in the detectors are earthed. The initial d.c. supply voltage is provided by a voltage doubler circuit and has a ripple content of about 5 V. This supplies the lamp current circuits directly; the lamp currents are controlled by transistors which are relatively unaffected by collector voltage variation provided they are not "bottomed", and the supply voltages are arranged so that this does not happen with the lowest mains voltage encountered (220 V with a nominal 240 V mains supply).



▲*Fig. 10. Complete diagram of signal circuits*

▼*Fig. 11. Lamp current stabilised supply circuit*



4. Accuracy

The operating accuracy depends mainly on the stability of the zero and signal magnitude of the level detectors. This is illustrated in Fig. 14 where the signal output has been taken as linearly dependent on liquid level. The pulse shaping circuits sharpen the resolution of level detection since they produce a full output pulse for a change of 0·2 V at their input (*see* Section 3.3). This is shown as the operating band in the figure. In practice, the counter which collects the output pulses also has an operating threshold so that the resolution is sharpened still further. A check carried out over a week with the detectors installed in a test stand showed zero drifts of less than 0·2 V and changes in signal magnitude between 4 and 6 V. The zero drift has been observed on various occasions to be within this limit. These figures for zero drift and signal magnitude have been used in Fig. 14, and show a possible error amounting to 0·010 in. in the position of the operating band.

Some further tests in which the level was slowly raised until the counter started for the lower detector, and stopped for the upper detector, gave an accuracy of 0·004 in. The level was observed with a cathetometer and 10 consecutive tests were carried out at each level detector.

It should be noted that the level detector is operated by the meniscus. As the flow rate is steady, this should be similar for both upper and lower detector units, but no evaluation of this has been attempted as the complete calibrating rig is not yet in operation.

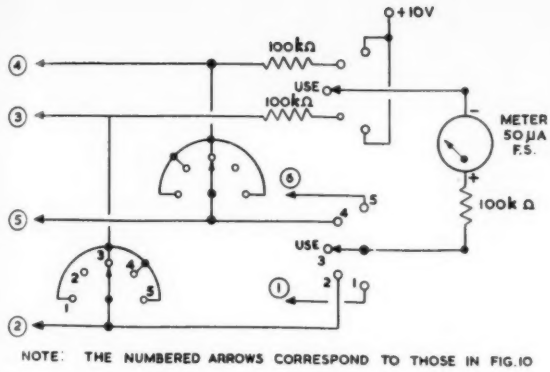


Fig. 12. *Meter circuit*

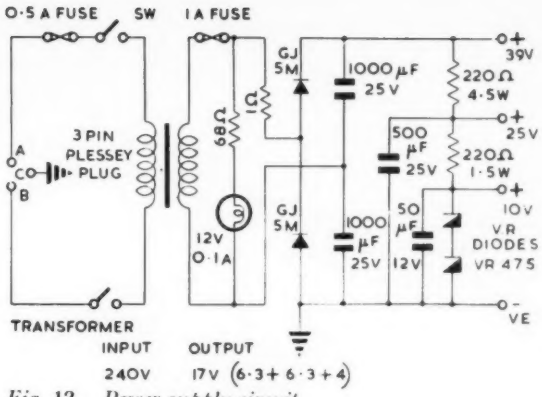


Fig. 13. *Power supply circuit*

It should be mentioned that the film of oil left on the detector operating surface does not affect the signal as it has the effect of an extension of the Perspex surface. This would be also true for thin films of liquids of a different refractive index from Perspex. It is possible that a film of an optically dense liquid would attenuate the light signal; however, no difference in signal was observed with oil that had been made very dark with dye. The most likely fault would be caused by a dirty volatile liquid that left an optically dense film on drying.

4.1 *Effect of Ambient Temperature Variation*

From 15°C to 30°C the light signal increases approximately from 4 to 6 V, and then decreases to about 4 V at 35°C. Above 35°C and below 15°C the signal decreases rapidly so that the normal working range is between these limits. This limitation is not due to the phototransistor; the makers' data show that the light current increases from 0·7 at 15°C, to 1·8 at 35°C, of the value at 25°C and this was confirmed by use of the test lamp. It is possible that this is due to the angle of incidence (45°) being too close to the critical angle 42°, so that small temperature changes of refractive index cause the critical angle to approach the incident angle. This has not been investigated further as 15 to 35°C is a satisfactory working range for this application since the oil is supplied at a constant temperature of about 21°C, and the ambient temperature in the laboratory remains between 18 and 25°C throughout the year.

Zero drifts, similar to those previously mentioned, of less than 0·2 V were observed during the temperature tests.

4.2 *Effect of Mains Voltage Variation*

Tests over the normal range of mains voltage of 220 to 250 V show that the light output signal varies approximately in the same proportion, that is, from 4·5 to 5·25 V while the zero drift is not affected. This is sufficient stability for the accuracy required and a considerable improvement on the performance of an electric filament lamp on an unstabilised supply. If required, the effect of supply voltage variation could be reduced still further by using another voltage reference diode on the base voltage potential divider (Fig. 11) and stabilising the +25 V supply.

5. Conclusions

A timer unit has been designed and constructed that is suitable under normal operating conditions for use with a volumetric calibrating tank of 0·1% accuracy. The liquid level detectors, devised for this purpose, that enabled an accurate yet reasonably simple equipment to be designed, could be used in many other applications as the same operating principle could be applied with other materials and shapes.

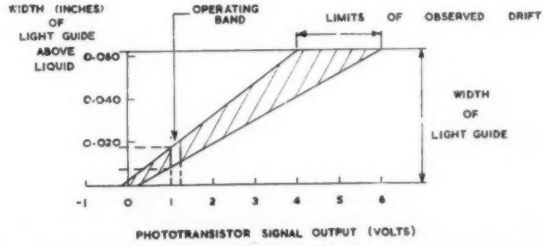


Fig. 14. *Effect of signal and zero drift on operating point*

Acknowledgements

The work of Mr. T. Ralston in the detailed mechanical design of the detector units, Mr. P. MacGregor in the layout and construction of the liquid level gate unit, and Miss M. B. Kent in drawing and also in design of a test stand are gratefully acknowledged.

The work was carried out in the National Engineering Laboratory, Department of Scientific and Industrial Research, and this article is published by permission of the Director.

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The properties of 70/30 iron-nickel-base and 70/30 nickel-copper-base alloys are described, with particular reference to their application in temperature-compensation of electrical measuring instruments employing eddy-current damping control. Measurements have been made, on a wide range of alloys, of the magnetic induction as a function of temperature and of the temperature of onset of transformation to martensite. From these data special alloys have been developed which possess both stability at low temperatures and better reproducibility of magnetic properties than commercial alloys now available.

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ALLOYS for Temperature Compensat El

Introduction

MANY electromagnetically controlled instruments, such as speedometers, watt-hour meters, etc., employ magnetic compensation to correct for the increase in electrical resistivity of the eddy-current disc and the decrease in magnetic flux of the control magnets which occur as the ambient temperature increases. In applications such as aircraft instruments, and domestic supply meters for outdoor installations, the possible variation in the ambient temperature may be considerable. In general, therefore, it is required that a compensation alloy shall possess a numerically large and appreciably constant temperature coefficient of magnetic induction over a temperature range of about 120°C (e.g., from −40 to +80°C) and that it shall be structurally stable at all temperatures to which the instrument is likely to be exposed. Finally, it must be possible to control the properties of the alloy closely from sample to sample, in order to obviate the need for wasteful and time-consuming testing and heat-selection of each batch of material.

In this paper the method of applying temperature compensation is briefly described, together with suitable parameters for comparison of various alloys used for this purpose. A large number of alloys were made, using three methods of production: air-melting, powder metallurgy and melting in vacuo or in an inert atmosphere. The results of a statistical analysis of the properties of these alloys are given and recommendations are made regarding the most suitable type of alloy for magnetic shunts.

Temperature Compensation of Electrical Instruments

A description of watt-hour meters and the application of temperature compensation therein has been given by Melsom[1]. The use of magnetic alloys in temperature compensation is more conveniently considered, however, with reference to the speedometer, shown diagrammatically in Fig. 1, in which a bar magnet revolves inside a metallic cup at a rate proportional to the speed of the vehicle. The magnetic flux linkage with this cup induces eddy-currents, which in turn interact with the magnet so as to produce a torque Q on the cup, which, to a first approximation, is given by the equation:

$$Q = K\frac{\phi^2 n}{\rho} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where n is the number of revolutions per second of the magnet, ρ is the specific resistance of the material forming the cup, ϕ is the total magnetic flux linkage with the cup and K is a constant. For constant resistivity and magnetic flux, the rotation of the cup against a restoring spring is thus proportional to the speed of revolution of the magnet. If, however, there is a change in the ambient temperature, T, the resistivity of the cup and the magnetisation of the magnet change. The resultant effect on the torque is given by:

$$\frac{1}{Q}\cdot\frac{\partial Q}{\partial T} = \frac{2}{\phi}\cdot\frac{\partial \phi}{\partial T} - \frac{1}{\rho}\cdot\frac{\partial \rho}{\partial T} \qquad \ldots\ldots\ldots (2)$$

For an uncompensated instrument, $\frac{\partial \phi}{\partial T}$ is negative and $\frac{\partial \rho}{\partial T}$ positive, so that the torque is too small above the calibration temperature and too large below it. It is usual practice, therefore, to shunt the permanent magnet, as shown in Fig. 1, with one or more strips of an alloy possessing a large negative temperature coefficient of magnetic induction, so that the flux linkage with the cup actually increases with temperature and thus compensates for the change in resistivity. If the cross-sectional area of the shunt is correctly chosen, it is possible to make the temperature coefficient of the torque, and hence of the instrument, substantially zero over a wide range of temperature.

The materials most often used for magnetic compensation have been iron-nickel-base or nickel-copper-base alloys. Stablein[2] described the use of an alloy containing about 30% nickel, balance substantially iron, whilst nickel-copper-base alloys containing various proportions of copper have been used singly and in combination by Kinnard and Faus[3].

The 70-30 iron-nickel alloy is usually preferred because it possesses a larger range of compensation,

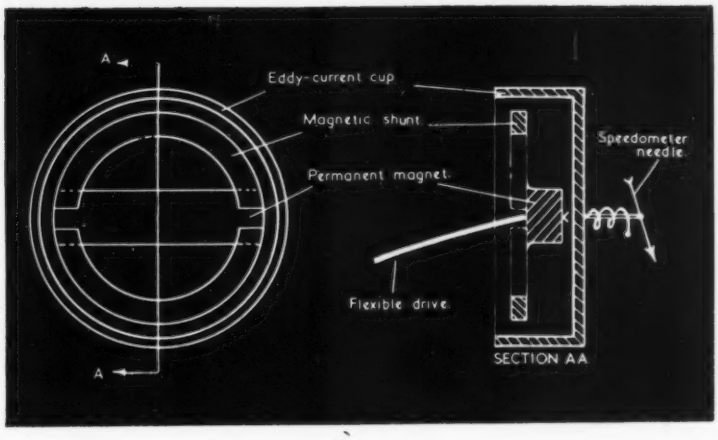

Fig. 1. Diagrammatic representation of a speedometer, showing use of magnetic shunts. A soft iron housing, not shown in the diagram, provides the flux return path for the magnet.

Electrical Instruments

typically about 120°C, compared with about 60°C for 70-30 nickel-copper alloy. A pure austenitic 70-30 iron-nickel alloy would undergo transformation to martensite on cooling below about −15°C, so that an instrument containing it would no longer be correctly compensated. The commercial iron-nickel compensation alloy, therefore, contains small amounts of other elements, usually carbon, added in order to depress the temperature of onset of transformation to martensite. In practice, due to partial decarburisation during melting and processing, or to partial oxidation of other elements such as manganese and silicon, the transformation behaviour is often uncertain. Inadequate control of composition also makes it impossible to predict magnetic properties from the nominal composition of iron-nickel-base alloys. Although the nickel-copper alloys are not subject to structural changes, they also are rarely produced with adequate reproducibility of magnetic properties from batch to batch of material.

In order to elucidate the factors affecting the magnetic properties and temperature of transformation to martensite, a study was made of a large number of alloys which varied in composition and had been subjected to varying heat-treatments. Additional elements from the series carbon, silicon, manganese, chromium, molybdenum and copper were added to the iron-nickel alloys to determine their effect on properties.

Since it is known[4] that manganese raises the saturation induction and depresses the Curie temperature of nickel, it was considered likely that similar behaviour could be expected when manganese was added to nickel-copper alloys. Several nickel-copper-manganese alloys were also made, therefore, to observe whether any increase in compensation range could be obtained in this way.

Where possible, three methods of production were used: conventional air melting, melting in vacuo or under argon atmosphere, and sintering of compacted powders, in order to determine which method gave best reproducibility of properties.

Experimental Technique

The sintered compacts or cast ingots were forged, hot-rolled, and finally centreless-ground to approximately 1 cm diameter rod. Lengths of about 25 cm were then cut for heat-treatment, which, in general, consisted of sealing the bars into a box made of Nimonic 75 alloy, raising the temperature to 800°C over a period of about half an hour, and subsequently removing the box from the furnace. Under these conditions the temperature of the alloys dropped below 200°C within 15 minutes, so that no appreciable transformation of austenite to ferrite could occur in the iron-nickel alloys. If carbon had been deliberately included in the alloy, the bars were annealed in an atmosphere of nitrogen, but for all other alloys purified hydrogen was used. In preliminary experiments, one alloy (No. 9 in Table 1) was subjected to the following heat-treatments:

1. heated to 800°C over a period of half an hour; air cooled
2. heated to 800°C over a period of half an hour: furnace cooled
3. held for 5 hours at 380°C after a short period at 800°C; air cooled.

No significant difference in the magnetic properties was observed, showing that in practice heat-treatment is important only in ensuring that the alloy is in an austenitic condition.

Each test piece was wound along its central portion with a 100-turn induction coil, which was connected into a circuit containing a ballistic galvanometer and the secondary winding of a standard mutual inductance. The test piece was immersed in a tubular glass vessel containing decahydronaphthalene. This compound has melting and boiling points of about −40 and 190°C respectively and is, therefore, suitable as a temperature-equalising bath over most of the range required. The glass vessel containing the alloy specimen was mounted on the axis of a tubular furnace, 100 cm long, which in turn was coaxial with an outer magnetising solenoid, of length 80 cm. The solenoid was non-uniformly wound so as to give a uniform magnetic field over a central region of about 30 cm. A thermocouple was attached to the test bar, near to the induction coil, the thermo-elements being 60-40 gold-palladium and 90-10

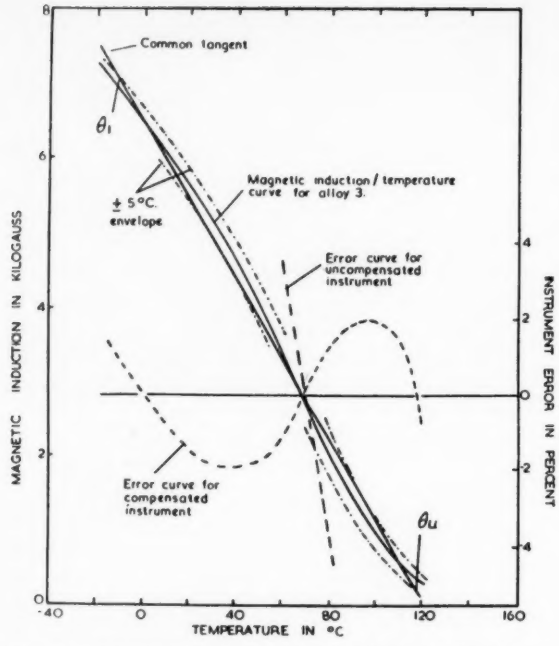

Fig. 2. Diagram to illustrate the method of determining the range of magnetic compensation ($\theta_u - \theta_e$)

platinum-iridium alloys. Using solid carbon dioxide mixed with decahydronaphthalene as a refrigerant, to obtain temperatures below the ambient, magnetic induction measurements by the ballistic method could be made from about −50°C to about 200°C, the range of applied field strengths being from 10 to 540 oersteds.

The temperatures of onset of transformation to martensite were determined from continuous-cooling curves obtained on a compression-type dilatometer as described by Allen, Pfeil and Griffiths[5]. The transformation temperature was taken as that corresponding to the first change in slope of the contraction-temperature curves. The samples for the dilatometer experiments were 1 in. length × 0·11 in. diameter and were machined from the heat-treated bars used in the measurement of magnetic induction.

The composition of all the alloys tested, together with method of manufacture and experimental results, are given in Table 1 for 70-30 iron-nickel-base alloys, and in Table 2 for 70-30 nickel-copper-base alloys.

Determination of Range of Magnetic Compensation

If A_s is the total cross-sectional area of the shunt strips, A_m is the cross-section of the magnet, and B_s B_m, are the magnetic inductions of the shunt and magnet, respectively, we have, neglecting flux leakage:

$$\phi = B_m A_m - B_s A_s \quad \ldots\ldots\ldots (3)$$

From equation (2) it follows that in an instrument incorporating a magnetic shunt, the temperature coefficient of the torque is zero at the value of A given by:

$$-\frac{2A_s}{B_mA_m - B_sA_s}\cdot\frac{\partial B_s}{\partial T} = \frac{1}{\rho}\cdot\frac{\partial \rho}{\partial T} - \frac{2A_m}{B_mA_m - B_sA_s}\cdot\frac{\partial B_m}{\partial T} \quad (4)$$

In order to obtain as large a torque as possible, the eddy-current cup is usually made from a metal of low resistivity such as aluminium or copper. For these elements, the temperature coefficient of resistivity, approximately 0·4%/°C, is usually much larger than the temperature coefficient of induction for the permanent magnet material. The temperature coefficient of the reading of an uncompensated speedometer is, therefore, about 0·4%/°C.

If x is the maximum permissible error in the instrument reading, the maximum departure, $\triangle T$, from the temperature of calibration for an uncompensated instrument would be such that:

$$\frac{\triangle T}{Q}\cdot\frac{\partial Q}{\partial T} = x \quad \ldots\ldots\ldots\ldots (5)$$

The range of compensation provided by a particular shunt material may therefore be obtained by translating its magnetic induction/temperature curve through $\pm\triangle T$, as shown by the dotted curves of Fig. 2. The slope of the common tangent to the displaced curves is taken as $\frac{\partial B_s}{\partial T}$ in equation (4) and the points of intersection with the "envelope" defined by the dotted curves give the upper and lower limits of compensation, θ_u and θ_l respectively. Over the temperature range $(\theta_u - \theta_l)$, the actual magnetic induction/temperature curve never departs from linearity by more than $\triangle T$ and, in consequence, the maximum error in the instrument reading is x, defined by equation (5).

In the work described here, $\triangle T$ has been arbitrarily fixed at 5°C. Since the temperature coefficient of the reading of an uncompensated speedometer is approximately 0·4%/°C, the corresponding maximum error over

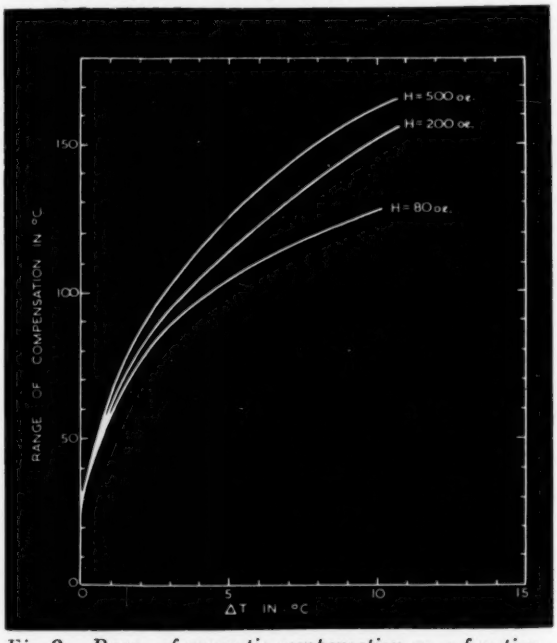

Fig. 3. Range of magnetic compensation as a function of $\triangle T$ applied magnetic field for a typical 70-30 iron-nickel alloy

the range of compensation ($\theta_u - \theta_l$) is about 2%. The way in which the readings of compensated and uncompensated speedometers vary with temperature is shown approximately in Fig. 2: both instruments had previously been calibrated at the same temperature.

In comparing the magnetic properties of various alloys, the magnetic induction corresponding to an applied magnetic field of 500 oersteds has been used. This is sufficiently large to enable demagnetising fields to be neglected. Fig. 3 illustrates, for a typical alloy, the dependence of range of compensation on applied magnetic field. Clearly it is advantageous to design the instrument in such a way that the compensating shunt is in a region where the magnetic field is as large as possible. The effect, on compensation range, of varying the magnitude of $\triangle T$ is also shown in Fig. 3. For $\triangle T$ less than about $\pm 2\frac{1}{2}$°C, i.e., an instrument accuracy better than 1%, the range of compensation decreases more rapidly.

Discussion

The results indicate that the range of compensation of 70-30 iron-nickel-base alloys is about 120°C, irrespective of relatively minor variations in composition. The method of least squares has, however, been used to provide statistically a general equation for upper limit of compensation as a function of composition. All alloys, whether made by air melting, powder metallurgy or vacuum melting, were given equal weight in the analysis, but two additional parameters, p and v, were also used in the equation to allow for the different residual impurity contents of alloys produced by the three techniques. The final equation for upper limit of compensation, in °C, is:

$$\theta_u = -986{\cdot}3(53{\cdot}7) - 8{\cdot}2(6{\cdot}9)p - 18{\cdot}0(8{\cdot}5)v + 36{\cdot}1(1{\cdot}7)Ni - 0{\cdot}0207\,(0{\cdot}0011)\,Ni^2Mn + 22{\cdot}1\,(2{\cdot}8)\,Cu - 10{\cdot}1\,(3{\cdot}9)\,Mo + 88{\cdot}7(35{\cdot}4)C - 39{\cdot}2(16{\cdot}9)Si \quad \ldots\ldots\ldots\ldots \quad (6)$$

In this equation, p is unity if the alloy is made by powder metallurgy and zero otherwise, and v is unity if the alloy is made by vacuum melting and zero otherwise. The compositions are expressed as a weight percentage and the figures in brackets give the standard deviations of the coefficients. The use of Mn aud NiMn terms instead of Ni^2Mn were also tried, but did not give such good agreement with the results.

For magnetic shunts, it is necessary that, in an alloy of particular composition, the upper limit of compensation should be reproducible to within ±10°C. The magnitudes of the coefficients in equation (6) indicate, therefore, that if adequate reproducibility of magnetic properties is to be obtained, production of the alloys by air-melting is unsatisfactory. In addition, it is not advisable to include readily oxidisable elements such as carbon and silicon in the alloys, since the actual amounts of these elements in solid solution will be difficult to control during heat-treatment and processing. By using methods such as vacuum melting and powder metallurgy, where close control of composition and low impurity content can be ensured, good reproducibility of properties has, however, been achieved. In Fig. 4 values of θ_u from Table 1 are shown as a function of nickel content for substantially carbon- and silicon-free alloys made by vacuum melting or powder metallurgy. Equation (6) is also plotted in this diagram, for comparison with the experimental points, which were first corrected to zero alloy content for elements other than nickel. The dependence of θ_u on molybdenum and copper contents is shown for the same alloys in Fig. 5, in which the values of upper limit of compensation are all corrected to a nickel content of 29%. It is clear that much better reproducibility of properties is obtainable by vacuum melting or powder metallurgy than is apparent from the standard deviations given by equation (6), which was derived by including, in the statistical analysis, the results on air-melted alloys.

As many of the alloys did not undergo transformation to martensite even on cooling in liquid nitrogen, insufficient results were obtained to permit statistical analysis of the dependence of martensite-transformation temperature on composition. In choosing a composition

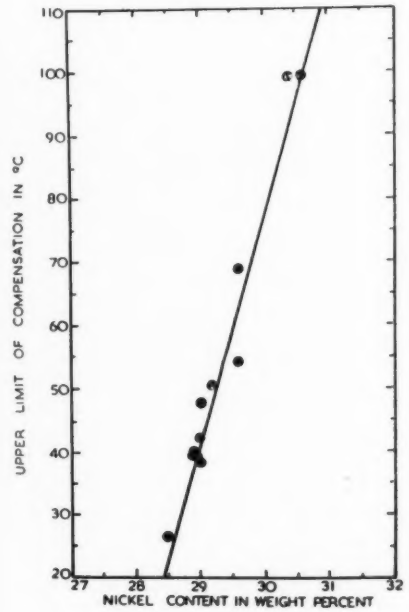

Fig. 4. Experimental points for substantially carbon and silicon-free iron-nickel alloys made by powder metallurgy or vacuum melting, compared with equation (6). The results are corrected to zero content of elements other than nickel.

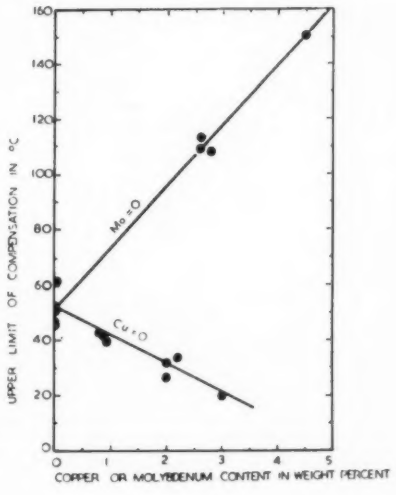

Fig. 5. Experimental points for substantially carbon and silicon-free iron-nickel alloys made by powder metallurgy or vacuum melting, compared with equation (6). The results are corrected to a nickel content of 29% and zero copper or molybdenum contents.

TABLE I

Properties of 70-30 Iron-Nickel-Base Alloys

Ref. No.	Composition (Weight %—Balance Substantially Iron)				Method of Production	Upper Limit of Compensation °C	Onset of Transformation to Martensite °C
	Nickel	Carbon	Manganese	Silicon			
1	28·9	0·13	0·53	0·28	a	51	−81
2	29·4	0·14	0·47	0·27	a	70	−82
3	30·6	0·18	0·52	0·23	a	120	−124
4	30·0	0·13	0·53	0·31	a	90	−100
5	28·7	0·16	0·58	0·34	a	27	−79
6	28·3	0·20	0·43	0·24	a	37	−74
7	30·7	0·16	0·47	0·21	a	124	−129
8	29·7	0·17	0·56	0·32	a	87	−116
9	29·9	0·10	0·48	0·32	a	78	−69
10	29·9	0·15	0·41	0·22	a	96	−85
11	31·3	0·02	2·31	0·04	a	99	< −190
12	30·6	0·14	2·38	0·05	a	75	,,
13	32·6	0·13	4·85	0·08	a	76	,,
14	33·9	0·11	7·29	0·13	a	66	,,
15	35·5	0·08	9·06	0·22	a	41	,,
16	31·3	0·03	0·16	0·84	a	99	,,
17	32·5	0·24	2·35	0·03	a	150	,,
18	34·0	0·16	7·00	0·15	a	94	,,
19	36·0	0·06	9·42	0·29	a	57	,,
20	32·8	0·16	5·06	0·08	a	89	,,
21	33·9	0·18	4·84	0·11	a	134	,,
22	35·8	0·21	7·07	0·14	a	126	,,
23	36·4	0·13	10·60	0·30	a	53	,,
24	33·7	0·20	2·52	0·05	a	178	,,
25	34·1	0·16	5·08	0·13	a	140	,,
26	36·8	0·14	6·89	0·23	a	130	,,
27	38·7	0·10	9·30	0·38	a	117	,,
	Nickel	Carbon	Copper	Molybdenum			
28	27·0	0·12	0·0	0·0	p	−30	−15
29	27·0	0·15	0·0	0·0	p	−18	−28
30	28·0	0·12	0·0	0·0	p	23	−27
31	28·0	0·19	0·0	0·0	p	34	−65
32	29·0	0·12	0·0	0·0	p	61	−44
33	29·0	0·17	0·0	0·0	p	78	−56
34	30·0	0·11	0·0	0·0	p	42	−53
35	30·0	0·17	0·0	0·0	p	108	−85
36	31·0	0·13	0·0	0·0	p	140	−68
37	31·0	0·17	0·0	0·0	p	153	−126
38	26·0	0·31	0·0	0·0	p	−30	−80
39	30·0	0·02	0·0	0·0	p	118	−2
40	27·5	0·22	0·0	0·0	p	24	−49
41	29·5	0·0	1·4	3·0	p	80	< −190
42	30·0	0·0	2·8	2·0	p	124	,,
43	30·0	0·0	2·6	2·0	p	125	,,
44	30·0	0·0	2·6	2·2	p	127	,,
45	30·1	0·0	0·0	0·8	p	83	−42
46	30·1	0·0	4·5	0·0	p	190	< −190
	Nickel	Carbon	Manganese	Molybdenum			
47	28·4	0·18	0·0	0·0	v	37	−32·6
48	28·6	0·19	0·0	0·0	v	38	—
49	29·4	0·03	1·07	0·0	v	35	−124·2
50	29·4	0·01	1·06	0·0	v	48	—
51	30·5	0·03	0·0	0·92	v	87	−80·5
52	30·1	0·02	0·0	0·86	v	73	—

a—air melting p—powder metallurgy v—vacuum melting

TABLE 2
Properties of 70-30 Nickel-Copper-Base Alloys

Ref. No.	Composition (Weight %—Balance Substantially Nickel)				Method of Production	Upper Limit of Compensation °C	Lower Limit of Compensation °C
	Copper	Manganese	Iron	Silicon			
53	23·8	7·8	0·11	0·16	a	−14	−99
54	13·2	10·1	0·05	0·02	m.a.	81	−19
55	3·98	12·4	0·29	0·26	a	116	27
56	trace	17·9	0·05	0·09	m.a.	56	−24

a—air melting m.a.—melting under argon atmosphere

for use as a magnetic-compensation alloy, it is satisfactory in practice to maintain the iron content at about 66% and then choose the percentages of the other elements from equation (6) in such a way that the upper limit of compensation is of the required value, usually about 85°C. Since the alloys used in obtaining equation (6) contained nickel in the range 28-36%, the nickel content of the final alloy should not lie outside this range. Provided the iron content does not exceed 66%, the martensite transformation temperatures will be suppressed to a temperature below −190°C.

As chromium is a common impurity in commercial alloys, it was considered desirable to obtain an estimate of the effects of chromium on the upper limit of compensation. A 2% chromium alloy, produced by air-melting, was found on analysis to have the composition nickel 31·3%, chromium 2·06%, manganese 0·25%, copper 0·06%, carbon 0·03%, silicon 0·02%, balance iron. The upper limit of compensation of this alloy was 99°C and it thus follows from equation (6) that addition of 1% of chromium depresses θ_u by about 21°C.

The results for nickel-copper-manganese alloys, given in Table 2, indicate that the presence of manganese increases the range of compensation: the composition for maximum range is approximately copper 13%, manganese 10%, balance nickel. This alloy possesses a compensation range of 100°C, compared with about 60°C for a binary 70-30 nickel-copper alloy. The best nickel-copper-manganese alloy is not therefore as good in magnetic compensation as the 70-30 iron-nickel-base alloys, but may find application if good corrosion-resistance is required. Within the range of compositions studied, the dependence of upper limit of compensation on composition is given approximately by the equation

$$\theta_u = 442 - 11{\cdot}6\ \mathrm{Cu} - 21{\cdot}1\ \mathrm{Mn} \quad \ldots\ldots \quad (7)$$

Manganese-bearing alloys are not easily produced by the powder-metallurgy technique and commercial alloys of this type would therefore preferably be made by melting in an inert atmosphere.

Conclusions

An equation is derived for the upper limit of compensation as a function of composition for 70-30 iron-nickel-base alloys. From the magnitudes of the coefficients in this equation it is deduced that air melting does not provide a satisfactory method of production unless there is routine testing of properties on processed material, followed by heat selection. It is also considered that, as far as possible, carbon and silicon should be excluded from the alloys, since the amount of these elements in solid solution is difficult to control during processing and heat-treatment. It is therefore recommended that the alloys should be produced by powder metallurgy, and, in addition, that the iron content should not exceed 66% by weight, in order to maintain low temperature stability. Good reproducibility of properties has been obtained also by vacuum meltings; compensation alloys could be produced on a commercial basis by this method.

It is also shown that alloys of the approximate composition copper 13%, manganese 10%, balance nickel, possess a wider range of compensation than the binary 70-30 nickel-copper alloy which has been employed as a compensating material. The magnetic properties of the nickel-copper-manganese alloys are less dependent on minor variations of composition, but possess a smaller range of compensation than the 70-30 iron-nickel-base type.

Finally, it should be noted that an alloy of composition 29·8% nickel, 1·4% copper, 3·0% molybdenum, balance iron, produced by powder metallurgy, has been tested by two instrument manufacturers and shown to give satisfactory temperature compensation in the temperature range −40 to +80°C.

Acknowledgements

The author wishes to thank The Mond Nickel Company for permission to publish this paper.

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THE AMOS IV COMPUTER

For a Prototype Automatic Weather Station

THE National Bureau of Standards in co-operation with the U.S. Weather Bureau has developed a specialised digital computer[1] for the Weather Bureau to use as a research tool in exploring the concept of the automatic weather station. The AMOS IV computer receives data from weather-sensing instruments and processes these data through such functions as sampling, comparing, selecting a maximum, and arithmetic operations. The results are transmitted via teletype to a central forecasting station and to other airport weather stations. Values of two quantities recently developed as aids to air safety—runway visual range and approach light contact height—are given by the machine through automatic table look-up.

For a number of years, the Weather Bureau has been appraising the possibilities of an automatic weather station. Such stations could be widely distributed, and would be especially useful in relatively inaccessible locations that are important sources of early data on meteorological activity. The various developmental prototypes of this concept have been called AMOS (Automatic Meteorological Observation Station); the current version, containing transistorised packages, is AMOS IV. This model was designed and built by Paul Meissner and J. A. Cunningham, of the N.B.S. Data Processing Systems Laboratory, and by C. A. Kettering, of the U.S. Weather Bureau. It is an outgrowth of previous work done by N.B.S. for the Weather Bureau that resulted in a special computer[2] for processing cloud-height signals from a ceilometer. The ceilometer was intended for use with the AMOS III.

Data Processing

Several of the input quantities to the AMOS computers, such as cloud height and precipitation, cannot be satisfactorily represented by instantaneous values but must be time-averaged. Varying amounts of data processing must, therefore, be associated with the different instruments measuring these quantities. In the AMOS III concept, several complex units were required for these functions. Although many of the functions were similar, the hardware was not minimised because of a diversity of design that resulted from the isolated development of the individual units. Analysis of the overall system indicated that a considerable reduction could be made in hardware and, therefore, in maintenance.

In AMOS IV, the automatic weather station is built around a single small, general-purpose computer designed especially for this application. The computer receives data from the input instruments at any desired interval. These data are suitably processed and arranged in a specified order for teletype transmission in a variety of message formats and at various speeds. The computer also operates local and remote displays. Much latitude is available for research into the most desirable form of data processing because of the inherent flexibility of the internally programmed machine.

Input Quantities

The computer continuously monitors new input data while simultaneously processing data already entered and transmitting messages on command. Among the input quantities which the AMOS IV computer can handle are temperature, dew point, wind speed and direction, atmospheric pressure, precipitation, transmissivity, and cloud height. Input data can be received directly from the instruments in the simplest possible form, such as analogue voltage, current, or resistance; and pulse rate or contact closure. Information may also be received in coded form, such as the Gray binary code frequently used with shaft-position encoders. The nature of the weather instruments and of the quantities measured limits the input data to 2 or 3 decimal digits for the most part; word size is, therefore, 3 digits plus sign. Double-precision methods are available for those few instances requiring greater accuracy. Communication with the machine is via electric typewriter or punched tape.

The computer circuitry is based on transistorised plug-in assemblies[3] designed at N.B.S. for a variety of data-processing applications. These 50 kc/s packages perform flip-flop, analogue switch, and gating circuitry functions, as well as others.

Data Storage

To store data, the machine uses a magnetic drum operating at 1,800 r.p.m. that carries 100 general storage channels of 100 words each and has space for 100 additional channels. Several dual-head channels are available for simultaneous read-in and read-out of incoming data, outgoing messages, etc. The magnetic drum provides the extensive storage capacity required for the table look-up involved in the calculations of

runway visual range and approach light contact height. About 35 tables are stored on the drum; each table has about 90 three-digit values.

One set of these tables contains the data on runway visual range (RVR), i.e., the distance along the runway visible to a pilot from the point of touchdown—generally 1,000 to 6,500 feet, depending upon runway illumination (natural and artificial) and atmospheric conditions. The primary input for the RVR determination is a transmissometer reading. The computer continuously monitors this reading and "looks up" the proper corresponding value of RVR, which is then displayed locally and inserted into the teletype message.

The other set of tables contains the data on approach light contact height (ALCH), i.e., the height from which the pilot can identify the approach lights. ALCH is affected by background illumination level, atmospheric conditions, and the intensity of the approach lights, which are set in accordance with prevailing conditions. If limiting conditions are indicated by either low clouds, as shown by the ceilometer, or by fog or snow, as sensed by the transmissometer, a value of ALCH based on the interfering factor is obtained. If both factors are present, two calculations are made; the machine then determines and displays the lower value. Since there is a statistical uncertainty in this type of information, two values of altitude are presented. The higher altitude is that at which the pilot has a 20 per cent probability of seeing the approach lights; the lower altitude is that at which the probability is 90 per cent.

References

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2. Cloud-height data analyser, *N.B.S. Tech. News Bull.* **43**, 1959, p. 180.
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NEW PATENTS

The following extracts have been taken from specifications obtained from the Patent Office, and permission to publish has been given by H.M. Stationery Office. The Official Journal *Patents* can be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2.

Patent No. 825,038. Electronic Switching Circuits.
Western Electric Company Inc. (*U.S.A. Application No.* 20208/58.)

The invention relates to electronic switching or "logic" circuits having a number of output leads, specifically those in which diodes are employed to perform the "logic" function. The term "AND circuit" is used to designate one which produces an output signal if all its input leads are energised and the term "OR circuit" one which produces an output signal when any of its input leads are energised. In the past, a limitation has been set on the freedom of design of logic and memory circuits by the necessity for matching the impedance of the output circuits, so that sufficient drive for each would be provided. It is claimed that the present invention provides means for driving several output circuits having significantly different input impedances from a single logic circuit. This object is achieved by providing separate output diodes and separate current sources for each output of the logic circuit.

Patent No. 826,330. Interferometer.
Carl Zeiss-Stiftung. (*Germany.*) (*Application No.* 3411/58.)

Interferometers designed in the past have not overcome inaccuracies due to sensitivity to external mechanical forces. This is due to the fact that the parts of the instruments producing the interference fringes are rigidly connected to the housing of the interferometers and, therefore, change their positions relative to each other upon alterations of the form of the housing resulting from such forces. This drawback is claimed to be overcome in the invention by the parts producing the interference fringes being arranged upon a common plate which is supported inside the interferometer housing with a certain amount of give. Two alternative means of effecting this are referred to in the specification.

Patent No. 826,342. Electronic Circuits.
Tinsley (*Industrial Instruments*) *Ltd. and F. L. F. Steghart.* (*Inventors: F. L. F. Steghart and P. L. Kershaw.*) (*Application No.* 18246/59. *Divided out of No.* 826,341.)

The invention is concerned with improvements in an electronic controller with proportional and integral elements described in the parent application referred to. The long time constant of the integral circuit makes use of a resistant-capacity network and, to satisfy the limitations of the rate of charge and discharge of the capacitors usable in such a network, the grid circuit of the output valve should contain a resistance of relatively high value. In most circuits, however, the grid resistance should be kept low if a reasonable life is to be achieved and this is in contradiction to the requirement mentioned. The object of the invention, therefore, is to reduce the effect of high resistances in the grid circuit of commercial valves in direct current amplifiers in electronic controllers.

Patent No. 826,725. Information-storage Apparatus.
The Solartron Electronic Group Ltd. (*Inventor: Francis Frederick Roberts.*) (*Application No.* 8507/55.)

The present invention is concerned with information storage apparatus comprising a storage screen so constituted that an optical characteristic of elemental regions thereof can be varied by a light beam falling upon such regions. This variation, retained for a limited time is later replaced by another variation. Means are provided to scan the storage screen through a lenticular plate with a light beam modulated in accordance with information to be stored in a raster

consisting of rows of spots, and provision is also made for varying the mean angle of the light beam incident on the lenticular plate, whereby the scanning takes place in a large number of rasters interlaced with one another in the line and frame directions.

Patent No. 827,037. Controlling Machine Tools.
The Sigma Instrument Company Ltd. (*Inventors: F. R. Boosey and E. H. Collins.*) (*Application No.* 28562/57.)

During automatic machining of workpieces, successively fed to a machine tool, the tool becomes worn and produces workpieces of a dimension greater than the permitted plus tolerance. It has been proposed that workpieces should be gauged directly after machining and that, when the plus tolerance limit is reached, the tool becomes automatically repositioned. Eventually, this is insufficient and the tool has to be dressed. Hitherto this has been done manually. It is claimed that the provisions of this invention automatically dresses the tool, whereafter it is reset to a position for successively producing correctly-sized workpieces.

Patent No. 827,165. Storage Arrangements Employing Magnetic Drums.
Gerhard Dirks. (*Germany.*) (*Application No.* 11068/58. *Divided out of No.* 827,163.)

The object of this invention is to effect track selection of stored information by physical movement of one or more magnetic heads and, alternatively, to provide a single movable magnetic head mounting which co-operates with two separate magnetic storage drums. The information storage apparatus comprises a rotatable magnetic storage drum provided with a number of circumferential storage tracks and a movable magnetic transducing head associated with the drum. Means are provided (a) to hold the head normally in an ineffective position away from the surface of the drum; (b) to move the head parallel to the axis of the drum to align it with a selected one of the tracks; and (c) to provide an electromagnetically controlled movement of the head towards the drum to bring it to an effective position. The arrangement is described and illustrated by way of an example which is also illustrated in the Application for Patent No. 827,163 where it is incorporated in a data signal storage apparatus having a number of aotatable storage drums.

Patent No. 827,207. Automatic Force Balance Device for Use in Computing, Controlling and Regulating Systems.
Foxboro-Yoxall Ltd. (*Inventor: C. W. Clarke.*) (*Application No.* 28703/56.)

This device is particularly applicable to analogue computers, more especially those for providing an output force which is the product or ratio of two input forces. The principle of the invention comprises the use of a lever which is mounted on a fulcrum carried on a second lever. Two variable forces are applied to the first lever, exerting opposed turning moments thereon, a variable force controlling the position of the second lever and negative feedback means sensitive to the movements of the first lever about its fulcrum. The feedback means determines one of the said three forces so as to restore the equilibrium of the system after disturbance by variation of one or both of the other forces. The forces may be produced by pneumatic or hydraulic pressures or, alternatively, by electromagnetic means such as solenoids. The negative feedback may be effected by the medium of a "nozzle and flapper" device used in a variety of automatic controlling and regulating systems.

ELECTRONIC TELEPHONE CENTRAL OFFICE

THE first electronic telephone central office was started recently by Bell Telephone Laboratories and Illinois Bell Telephone. It is the first system which performs electronically all the functions in handling telephone calls.

Method of Operation

The method of operation is briefly as follows: A scanner checks the condition of every telephone line ten times a second, day and night. When a subscriber picks up his telephone to make a call, the scanner detects the action and signals it to the common control.

The barrier grid store shows that this is a new call because its record shows that a tenth of a second earlier the phone was in the "rest" position. The barrier grid store also reports no record of anyone trying to reach this line so the common control decides the customer wants to dial.

The ECO machine sends a dialling tone to the customer showing him that the system is ready to handle his call and space is reserved in the barrier grid store for the digits to be dialled. The speed of the scanner now increases to 100 times a second so that none of the dial pulses will be missed.

Memory System

The requirement of the memory system was very large capacity and almost instantaneous access to stored items.

Bell Laboratory engineers decided to store information on photographic plates. A cathode ray tube produces a small spot of light which can be positioned to read out stored information from the plate. For each position of the spot of light, different items of information can be read out.

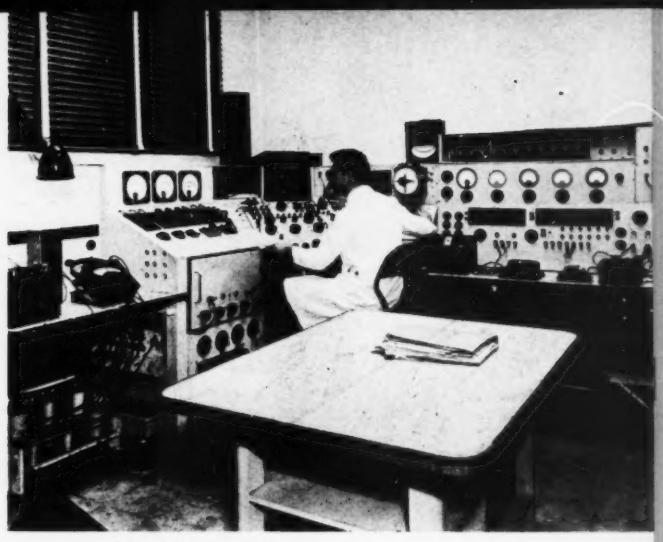
In the flying spot store $2\frac{1}{4}$ million items of information are stored and any item can be read in a few millionths of a second. All the $2\frac{1}{4}$ million items can be read in $\frac{1}{5}$th of a second.

Barrier Grid Tube

The barrier grid tube is a special type of electron tube with a mica target. A beam of electrons is shot at the target and a charge or lack of charge on any part of the mica represents an item of information. The item can be read quickly, then erased, leaving the space ready for new information.

The end result of the whole system is to direct the closing of switches to connect one telephone with another. The switches are neon gas tubes.

One of the calibration and testing bays of the new general test room



A corner of the sub-standards room

NEW TEST ROOM TO STEP-UP PRODUCTION

WORLD markets call for quicker deliveries from British manufacturers. This factor has been given special consideration by Nalder Brothers & Thompson Ltd., and reorganisation for speedier production has now been completed in the company's works.

Quality production has always been foremost in the firm's planning, but with world development moving at a rapid rate it has been recognised that *quantity* production must move faster in order that the company may hold its place in world markets for standard and specialised instruments.

Vital factors in instrumentation are accuracy and reliability, and the calibration and testing department provides an essential link in the production of electrical instruments.

The new test room, developed over a period of three years, has now been completed to meet the growing demand for the company's instruments, attention has been paid to specialised instrument production.

The Main Test Department and its sub-divisions have, in fact, been completely rebuilt and re-equipped. Ease of handling of all work, including the testing of each individual instrument before despatch, has been given special attention. A conveyor transports all instruments from the assembly bays in the works to the test room, and this is used also for the transit of completed instruments from test room to despatch department.

Since it is necessary to make many wire connections in the routine of calibration and testing of instruments, special cables have been installed in ducts below the test room flooring, and all testing circuits are completed by twin or multiple cables connected by plug and sockets on the test benches to standards and instruments for calibration. Power supplies from both mains and independent machines, such as frequency changers, are available on most benches.

This system of connection eliminates errors, and all test benches are clear of wiring.

Switching of supplies for calibration and testing is mainly by push-buttons, since the machine units for power supply, etc., are installed in special rooms outside the test department where they can be easily inspected for maintenance.

The test room is fitted with 40 test desks, complete with all necessary instruments, each specially designed and constructed for the various instruments made by the company and allocated in special sections for tests, as follows:

1. Calibration and testing of all patterns of ordinary ammeters and voltmeters, both switchboard and portable type
2. Three-phase instrument calibration and testing
3. Frequency meter calibration and testing
4. Overload, directional and specialised relay calibration and testing
5. A special scaling production department dealing with the individual scaling and accurate printing of instrument scales following calibration
6. A sub-standards department, the function of which is to calibrate and test all standard instruments ordered specially by companies or government departments, and to continuously check all standard instruments used in the test room for general calibration purposes.

For instruments which are ordered for service under various climatic conditions, a special humidity cabinet has been installed. The cabinet is thermostatically controlled and automatically timed, and it ensures that instruments are tested under climatic conditions similar to those specified by the customer.

For high-frequency and three-phase calibration and testing, special machine units are available in the form of motor generator sets with completely remote controlled starter, speed and power factor. One such unit is thought to be the only machine installed in this country for carrying out this type of work. It consists of a motor, driving four three-phase generators, namely a voltage generator, a frequency doubler and a current generator with its own frequency doubler. It has a range of 100-800 c/s, with complete phase-angle control from zero lag to zero lead.

Thermostatically-controlled heating, together with a high standard of illumination, ensure conditions of working that are ideal, not only for quality production, but also for the comfort of the employees.

Dr. A. C. Menzies
and
Professor R. V. Jones

SIMA Convention 1960

POINTS FROM THE DESIGN PANEL

Introduction

THE theme of the 9th SIMA Annual Convention at Eastbourne from 17th-20th November, 1960, was Productivity. In all there were four panels devoted to the subjects of Design, Management, Floor Production and Sales. It is thought that a summary of the Design Panel may prove the most interesting for readers of this journal. The Design Panel involved four sessions: Designing Instruments for Scientists, Designing for Appreciation, Designing for Comfort—Ergonomics and the Unconscious Mind, and Designing for Production.

Design Panel

Chairman: Dr. A. C. Menzies

Session 1. *Designing Instruments for Scientists*

The speaker was Professor R. V. Jones, C.B., C.B.E., Professor of Natural Philosophy at Aberdeen University.

Professor Jones specified a number of points. These were:

1. High performance as exemplified in a typical instance by the signal/noise ratio
2. Stability, for example against ambient temperature changes, aging, wear, and so on
3. Sensitivity. A good range of sensitivity should be available
4. Ease of control. In this connection scales should be easily read. There should be freedom from backlash. Where a specimen has to be inserted in an instrument this should be capable of being performed easily
5. Design should be matched to purpose. Mechanical features tend to be neglected
6. Flexibility
7. Appearance
8. Servicing. Full information regarding the instrument should be available as easily as possible. Where service is required it should be prompt, and the right type of serviceman should be employed
9. Expense may not be an over-riding factor, as a customer may be prepared to pay for high performance.

Professor Jones considered that manufacturers could, with advantage, bring into development discussions relevant personnel from Universities, Governments, and other concerns at an earlier time than is normally the case.

Discussion

In the discussion the following main points were dealt with:

1. The German radar, to which reference was made by Professor Jones, although better in some technical points, was not as flexible as ours
2. There are two schools of thought on accessibility.

Sealing an instrument prevents ignorant personnel damaging it. On the other hand, ease of access is useful for replacing spares on the spot, and so obviating return of the instrument to the manufacturer

3. Stability and reproducibility are important. A Ministry example was quoted of 500 instruments given a routine test. The somewhat large fraction of 20% were found to be outside specification. These had all been in constant use, and had, therefore, been producing misleading observations. The question of cost arose relative to long or short term stability. The former could cost a lot more than the latter
4. Instruction plates were suggested as an alternative to manuals.

Session 2. *Designing for Appreciation*

The speaker was Mr. H. Upjohn, M.S.I.A., Council of Industrial Design. Mr. Upjohn stated that competitive markets demand aesthetic appearance of products, and European markets may be prepared to accept a higher standard of design than that which satisfies the home market. Some continental countries are fairly well advanced in their general aesthetic appreciation. There is an example of the Bauhaus in West Germany. The ergonomic aspect should be considered in design.

Discussion

1. No courses seem to exist in this country to train designers for aesthetic appeal. The Central School of Arts and Crafts could possibly train mechanical designers for such a purpose. But could a course in pure art satisfy the particular need?

   At present firms have to rely on their own efforts, and two member firms instanced engineers with artistic flair being given the best training available. The Council of Industrial Design has a list of 2,000 names of art designers available as consultants
2. Could SIMA help in initiating a working party for considering classes for designers? The suggestion will be considered, although the number of products involved in the scientific industry was relatively small.

Session 3. *Designing for Comfort—Ergonomics and the Unconscious Mind*

The speaker was Dr. S. Black, M.R.C.S., L.R.C.P., Consultant to Ergonomics Ltd.

Dr. Black drew attention to the subject of Ergonomics, which involves, very briefly, fitting the job to the worker. Experimental psychologists have made many contributions to the field of ergonomics, particularly in establishing an objective view of human behaviour in experiments involving measurement. The conception of the human mind is important here. If it is broadly pictured as a series of layers, in our normal working life we are unaware of what occurs in the deeper layers. An artist may delve into the unconscious region to produce results. Again, a conflict between conscious and unconscious may result in a product not selling. Hypnosis is suggested as a means of exploring the unconscious mind.

Session 4. *Designing for Production*

The speaker was Mr. A. H. Willoughby, Technical Manager, Osram Lamp Division, General Electric Co. Ltd.

Mr. Willoughby explained that his division was essentially concerned with production. In the division, 1,500-2,000 domestic lamps are manufactured per hour. On the other hand, special types may be more or less hand made at the rate of 50-100 per week.

The division is equipped with Plant Design and Product Design laboratories. There must be extremely good liaison between development and production staff, and to further this selected personnel from development work in production for three months, and production personnel work in development for three months. Where do development projects start?

1. From the research laboratories
2. From old literature
3. From a demand
4. From a factory request
5. From contact with suppliers of materials and machines.

The second source mentioned may be a little surprising, but two examples will show that it is not an unimportant one. Coiled coil lamps were first proposed by Langmuir in 1913. But it was not until 1937 that the first exploitation was made; 1960 saw the lamp generally accepted. The Nesta form of lamp bulb was first developed by a Hungarian lamp firm with krypton filling. This proved too expensive, but the modern version has now been recognised as the lamp of the year.

In this connection, each laboratory has a person attached whose duty is to examine all relevant literature, but the development staff themselves are given every encouragement to read articles of importance in working hours.

Each development is discussed at an early stage at management level, and includes the marketing and costing sides. There is a project team at lower level for some developments affording an excellent training ground for the younger engineers.

Target dates for completion of development are always given and a brief monthly progress report is maintained on a Rota-card device.

Discussion

1. Small batch developments are not necessarily referred to the central research laboratories
2. For large projects, there is an estimated development cost
3. During progress of development, modification requests may be received from sales engineers and similar personnel. A firm line must be taken regarding the number of these which can be accepted, otherwise completion of development can be seriously delayed.
4. The production side is brought into the project at the start, since raw materials have to be ordered and there is always a possibility that many components will remain unmodified during development.

SIMA Notes

THE month of November has been a particularly active one for the Association, and the 9th Annual Convention which was held at the Grand Hotel, Eastbourne, from 17th to 20th November was the principal event. The business of the Convention was based on the theme "Productivity" and a most distinguished gathering of speakers ensured the overall success of the Convention. 168 delegates and 84 ladies attended, and all the sessions were well attended. Although it would be difficult to distinguish any particular session, perhaps the highlights were the talk on "The Personal Angle" by Mr. W. J. Carron, President of the Amalgamated Engineering Union and Chairman of the British Productivity Council, and the demonstration by Dr. Stephen Black of his methods described during his talk "Designing for Comfort—Ergonomics and the Unconscious Mind".

The Dinner-Dance which concluded the Convention on the Saturday evening was attended by 211 members and their guests. The principal guests were Alderman Miss G. L. Parker, M.B.E., J.P., The Mayor of Eastbourne, who welcomed the Association back to the original venue of its earlier Conventions, and Professor R. V. Jones, C.B., C.B.E., deputising at very short notice, who replied in a very witty speech on behalf of the guests.

At the meeting of the Council, held at Brown's Hotel on Thursday, 1st December, Committee Chairmen reported on their respective Committees, and among the business discussed were future SIMA events, including the Annual General Meeting and the 10th Convention, and tariff negotiations with Commonwealth countries. Lancashire Dynamo Electronic Products Ltd. were elected to membership of the Association. The Apprenticeship Certificates of the following member firms were endorsed by the official seal of the Association, indicating that a course of instruction approved by the Association had been carried out:

C. Baker Instruments Ltd.	...	1
Foster Instrument Co. Ltd.	...	2
Wray (Optical Works) Ltd.	...	2

The Export Committee, under their Chairman, Mr. P. Schilling (Stanton Instruments Ltd.), held a meeting at SIMA House on Wednesday, 9th November, and at this meeting a variety of matters were discussed including reports on the Interkama Exhibition, and of a meeting of exhibitors who had taken part in the Moscow Exhibition in June of this year. Considerable discussion was directed to future policy for exhibitions and SIMA co-operation at a number of international exhibitions. Other business included some remarks on the impact of imports of Japanese instruments and forthcoming trade negotiations, of which SIMA is being notified in advance by the Board of Trade. As a result of discussion on the Export Credits Guarantee Department, a delegation visited the Department on 14th November, and had a most useful discussion with Mr. Dickinson, the Director of the General Division and a number of members of the London office.

The Publicity Committee (Chairman, Mr. F. W. Dawe, Dawe Instruments Ltd.) held a meeting at SIMA House on Tuesday, 15th November. The business was largely devoted to arrangements for the forthcoming first edition of the *SIMA Review*. This publication is to replace the *SIMA Bulletin*, and will be published twice annually, in January and July. Among the other matters discussed was a report covering the first year of his work for the Association from the Press Relations Adviser, Mr. Ivor B. N. Evans. Prior to this meeting, members of the Committee attended a luncheon at the Connaught Rooms at the invitation of Mr. C. C. Gee.

Under the Chairmanship of Mr. A. W. Smith (Wray Optical Works Ltd.) the Education and Training Committee met at SIMA House on Thursday, 24th November. At this meeting it was reported that the Council had agreed that SIMA should become an honorary member of the International Association for the Exchange of Students for Technical Experience. Considerable discussion was devoted to the SIMA apprenticeship endorsement scheme, and a number of amendments and additions to the present scheme were considered and accepted.

Mr. G. A. Whipple (Hilger & Watts Ltd.) was unanimously elected Chairman at a meeting of the Technical and Standardisation Committee, held at SIMA House on Tuesday, 22nd November. This was the second meeting of this Committee, but the election of a Chairman had been held over until this meeting because a number of members had been unable to attend the first meeting. Items on the agenda included some remarks on the terms of reference and method of work of the Committee, and consideration was given towards the action necessary to co-ordinate terms and methods in the field of ultrasonics.

Dr. J. Thomson, Director of the British Scientific Instrument Research Association, was Guest Speaker at a luncheon preceding a meeting of Section 1 (Optical and Ophthalmic Instruments, Precision Cameras and Lenses), and Section 2 (Navigational, Surveying, Geophysical, Metrological and Prospecting Instruments), held at the Connaught Rooms on Wednesday, 29th November. Dr. Thomson gave a most interesting talk on "Future Trends in the Optical Industry" and included some remarks on recent advances in this industry.

At the business meeting which followed the luncheon, which was attended by representatives of twelve member firms, the President, Mr. G. C. Ottway, in his opening remarks, reminded members that this was the first meeting of these two sections for a number of years, and that in view of the present trend in the industry, as had been pointed out to them by Dr. Thomson, there was a need for an active and lively section, from which all members concerned would benefit. Business discussed during the meeting included the election of a Chairman, and the training of glass working apprentices, upon which subject some interesting proposals were put forward. Mr. M. G. L. Curties (C. Baker Instruments Ltd.), who was unfortunately unable to attend at the last moment, has been invited to accept the Chairmanship of Section 1. Other business included some remarks on recent tariff negotiations and the importation of Japanese instruments, and members present were reminded of the forthcoming Conference on Optical Instruments and Techniques which is being held in London in July, 1961.

Solid State Switching—

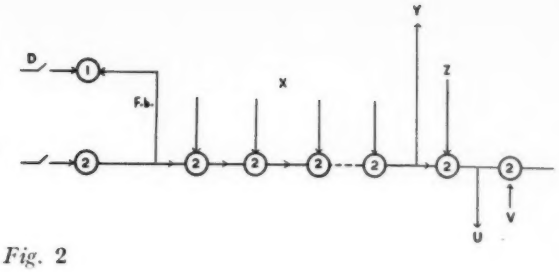


Fig. 2

New Railway Signalling System

Introduction

BRITISH RAILWAYS are to install what is believed to be the first electronically-operated system of signal interlocking in the world in Henley-on-Thames signal box. The new system has successfully completed its laboratory tests and will be installed in this branch-line signal box in the Western Region for full-scale trials.

Until now interlocking has been effected either by mechanical locks or, in more modern installations, by electrically-operated magnetic relays. These will be replaced in the Henley installation by electronic circuits incorporating transistors, semiconductor diodes, and ferrite cores. The principal advantage of electronic circuitry is that it has no moving parts and could, therefore, lead to important savings in maintenance costs.

Adoption of electronic interlocking for future signalling schemes will depend largely upon its ability to surpass the outstanding reliability of magnetic relays, which can operate for a minimum of five years in a sealed box and have a failure rate of only one in thousands of millions of operations.

Figs. 1 and 2 depict the essential features of a model which can be used for explanation purposes. It operates on the conventional "entrance-exit switch and push button" system, and track and point indication is provided. The only relays used are track relays. The tracks are shown divided up into a number of signalling sections as in Fig. 1.

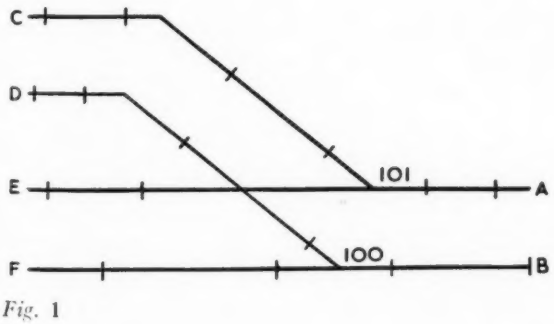


Fig. 1

In order to set up a route on the model, for example, in the direction B to D (see Fig. 1), the direction switch at B is set to direction B to F and the exit button at D is pressed. This action results in the points 100 and 101 being moved to the reverse position. These points are interlocked and the sequence is that 101 is reversed first, and when it has been detected as being reversed, the points 100 are reversed. However, this route B to D can only be called provided that the information from the track circuits involved indicates that there is no vehicle on the track and also that the points are not locked—that is to say, that a prior route has not been set up along, for instance, E to A.

A simplified example of a sequence of events is shown in diagram 2.

The pulse from the push-button at D is fed to an "Or" gate which sets up a feedback path Fb to maintain the circuit. The output from the "Or" gate is fed, together with the signal from the switch at B, to the "And" gate which then, and only then, gives an output to the first track circuit "And" gate. The track circuit "And" gates are denoted by X in the figure. This input, together with the input from the track circuit (providing this is clear), will result in an output to the next track circuit "And" gate and so on. After all the track circuits have given the information that they are unoccupied, the points 101 are reversed, providing they are not locked, and the signal from the track circuits, together with the information that 101 is now reversed and locked, is fed to another "And" gate. The points 100 are now reversed and locked, and this information, together with the output from the last "And" gate, is fed to the final "And" gate, the output of which clears the signal at B (see Fig. 1).

Y represents the signal path to set 101 reversed if not locked. Z represents the signal path to set 101 reversed and locked. U is the signal path to set 100 reversed if not locked and V the signal path to set 100 reversed and locked.

This is a logical process and if for any reason the required information does not reach any one of the "And" gates in the chain the sequence will be broken and the route will not be cleared. When a route has

been cleared and a train travelling in the direction B to D, for example, has passed over the first track circuit in the route, the signal is automatically returned to red. Although the direction switch is still set, this route cannot be used again, by pressing the exit button, until the whole sequence of calling has been repeated.

In addition to the interlocking of the points and the use of track circuits, there is also a device whereby if a signalman has set up a wrong route (B to F instead of B to D for instance) he is unable to reset the route immediately if a train has already entered the approach track circuits. He can, however, set all the signals to red, and after a suitable time delay, to allow the train to stop, the route can be reset. Obviously if this device were not included a signalman would be able to reverse the 100 points, which may not complete their movement before the train reached them and thus cause a derailment.

The logic system can, therefore, provide an anti-preselection device and an approach locking device to meet signalling requirements.

Track circuits of the normal type are used.

The electronic logic units from which the system is constructed are of the plug-in type. They are designed to operate safely in ambient temperatures between -20°C and $+50^{\circ}$C. They employ Mullard transistors, semiconductor diodes and ferrite cores.

The "fail-safe" electronic technique outlined is based on the company's experience in the application of modern electronics to safety problems. The present equipment has been designed to meet the requirements of British Railways, but it is generally applicable to railway systems anywhere in the world.

Computer Control of Generating Plant

A 342,000-KILOWATT generating plant now being constructed by the Public Service Electric and Gas Company of New Jersey in the United States will operate under the control of a digital computer system developed by Westinghouse to increase station reliability and efficiency through automatic operation. Installation of the Prodac computer control is scheduled to begin in late 1961 on Unit 5 of the company's Sewaren Generating Station, about 10 miles south of Newark in New Jersey. When operational in early 1962, it will be the first Prodac control computer built by Westinghouse for the automatic control of a generating station and among the first applications of the new computer for industrial process control. Scheduled for service before 1962 are several Prodac computers designed by Westinghouse for process control in the steel industry.

The computer will have the ability to start, operate, and shut down the boiler, turbine-generator, and plant auxiliaries in accord with pre-established programmes for both normal and abnormal conditions. Operating programmes will be read into the computer control from punched tape, stored for use as needed in a memory unit, and executed according to computations based on process data received from hundreds of sensing points throughout the plant.

The system will assimilate the output of instruments and relays at high scanning rates and will process this data and other data in storage to compute heat rates, boiler and system efficiencies and other indexes necessary to optimise plant operation. It will also log and display the status of all key plant functions periodically or upon the operator's command.

The computer control system will provide the station operator with close control of the unit at all times, but stored programmes will cover all conceivable operating conditions and will apply to all main unit functions. Controls for the major analogue-type sub-loops normally provided for plants of this type will be modified to permit complete integration with computer control. Many of these sub-loop control systems will be continuously monitored by the computer at the same time as it is performing calculations and issuing control signals for optimising unit operations.

The computer will be built for service in industrial environments; it will use solid-state components exclusively except for the mercury-wetted relays used to switch inputs and outputs.

The computer's main memory will be a combination of magnetic core and magnetic drum storage which will give the computer the fast access time of random-access core memory and the large storage capacity of a drum memory. An important element of the system will be a priority director unit which will provide a means for a programme of high priority to supersede a lower priority programme in process. When suspension of a programme is necessary, information and data for the suspended programme will be transferred to storage so that the programme can be resumed. Eight different priority levels will be provided for assignment to various pre-established control actions.

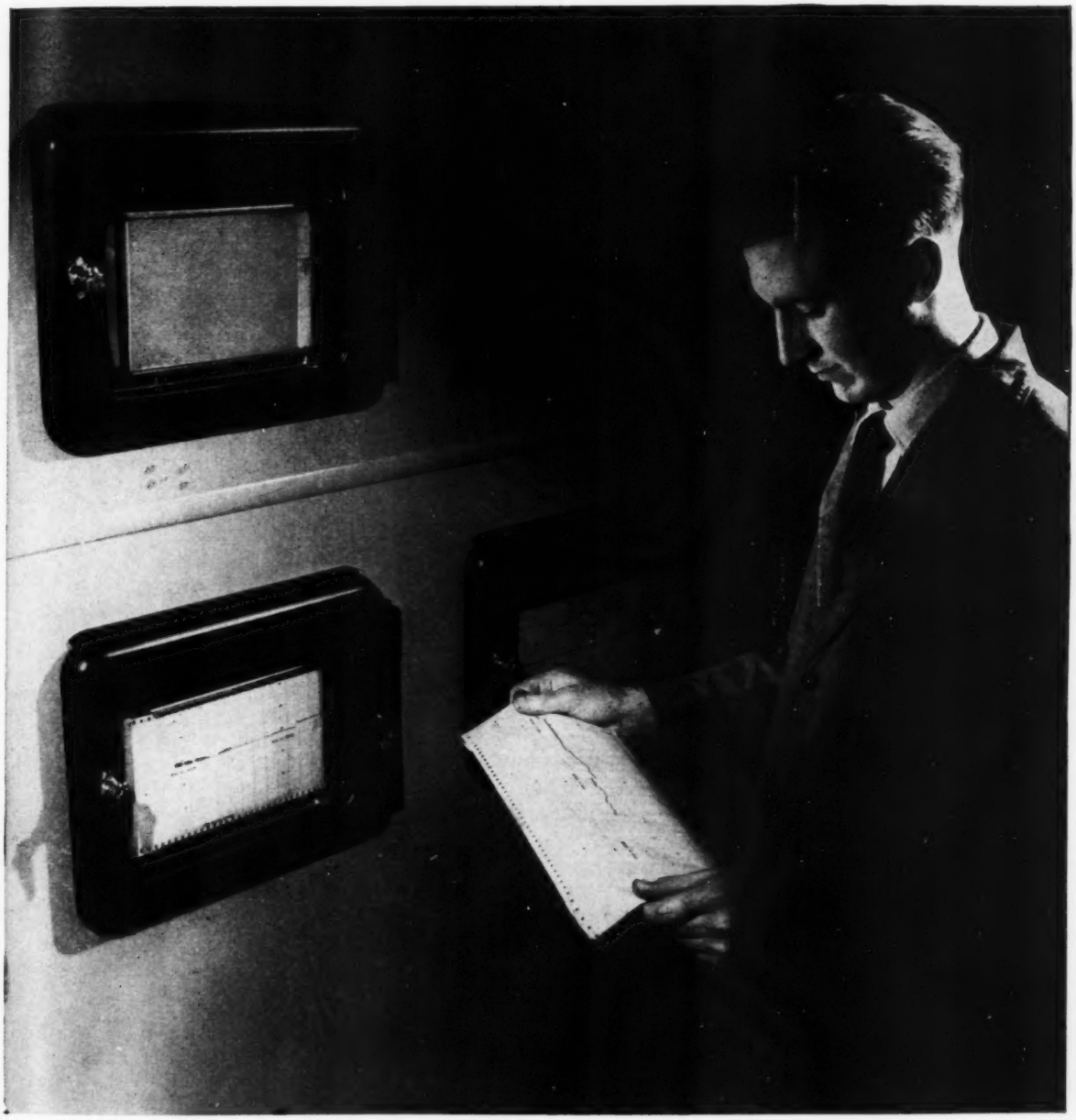
The computer will be built to accommodate as many as 1,500 input signals from the station's instrumentation and control points. Roughly one-third of these will involve binary signals corresponding to contact closures, with the remainder being divided among high-level analogue signals (one volt or more), low-level analogue signals (10 to 1,000 millivolts), and counter pulses. Outputs from the computer will comprise about 500 contact-closure (on/off) outputs, and 28 analogue outputs. There will also be an alpha-numeric input-output unit for data logging and communication between operator and computer.

Major equipment to be controlled by the system will be a universal pressure boiler built by Babcock and Wilcox and a cross-compound steam turbine driving two 208,000-kVA inner-cooled generators. Designed by Westinghouse, the turbine-generator equipment will provide a number of special sensing devices and control operators for automatic operation. These special provisions include a wide speed range electric starting governor, an automatic synchronising system, and automatic turning gear control.

Circle 170 for further information

He reads it easily...

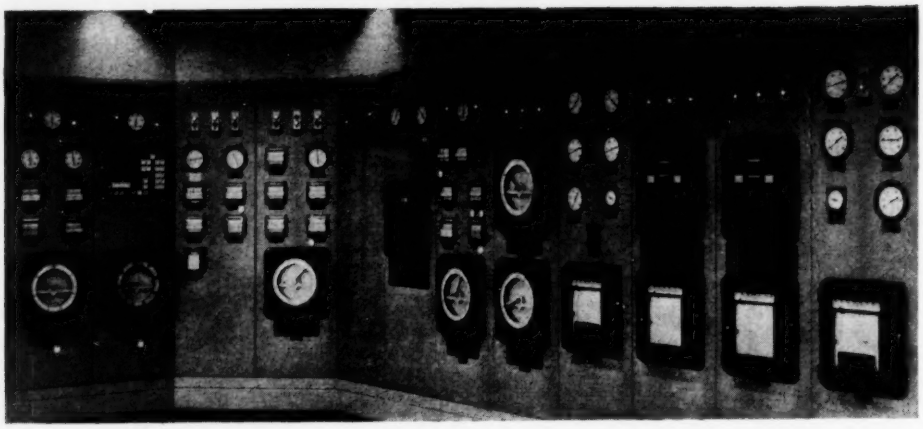
A clear record of the last two shifts—and the pen already beginning its course on the next chart. In his hand he has the past: on the panel is the present. Arkon Recorders measure gas, air, steam, water and effluent flow, pressure or vacuum, or pressure and vacuum; flows in one inch pipe or 36 inch mains, pressures from 0.1 inches water gauge to 500 lb. per square inch. They give a clear, unmistakable record which you can read like a book, without hesitation and without mistakes. You can leave the chart on for a few hours, a day, or a week—the record will always be there. Easily read, easy to look after, robust enough to stand on the job, Arkon Instruments can help the control of any process—and their accuracy will satisfy even the men in the lab.



More about Arkon recorders in pamphlet AB 110

WALKER, CROSWELLER & CO. LTD · CHELTENHAM · Tel: Cheltenham 56317

Circle 171 for further information



Speedomax

Instrument Installation controlling Olefine production at

I.C.I.

WE are indebted to Imperial Chemical Industries Limited for the above photograph of a small part of the Speedomax instrument installation controlling olefine production.

THIS special installation, of course, involved considerable consultation and collaboration between I.C.I. Instrument Engineers and our Research Staff. No matter how simple or complex your problem, we will be glad to hear from you and to give you any assistance in our power.

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SURVEY OF NEW INSTRUMENTS

ELECTRICAL · ELECTRONIC · MECHANICAL · NUCLEONIC · PNEUMATIC

Transistors—New Types

STANDARD TELEPHONES & CABLES LTD. are introducing the following new transistors:

TK33C. A germanium n-p-n alloy junction transistor having a cut-off frequency between 3 and 8 Mc/s. It is suitable for industrial applications in high-frequency switching circuits and is complementary to the p-n-p TK30C type. Sample quantities are available.

TK34C. A germanium n-p-n alloy junction transistor having a cut-off frequency above 8 Mc/s. It is suitable for industrial applications in high-frequency switching circuits and is complementary to the p-n-p TK31C type. Sample quantities are available.

TK45C. A germanium p-n-p alloy junction transistor for audio frequency amplification and general-purpose low-frequency applications, especially where a low noise factor is required. Figures of 2 dB (typical) and 5 dB (maximum) are given for the following conditions:

frequency = 1 kc/s
source resistance = 600 ohms
$V_{CB} = 4{\cdot}5$ V, $I_C = 0{\cdot}5$ mA.

The TK45C is available generally.

TK46C and TK47C. These are germanium p-n-p alloy junction transistors specially suited to industrial low-gain amplification and low-level switching applications where relatively inexpensive devices are required. They each have a minimum common-base cut-off frequency of 0·5 Mc/s and minimum current gain figures of 15 for the TK46C, and 20 for the TK47C, both gain figures being measured at $V_{CB} = 0$, $I_C = -5$ mA.

Both types are available generally.

TK200A. A silicon diffused n-p-n power transistor for applications in ferrite core switching circuits and power oscillators working at frequencies up to about 10 Mc/s. It has a minimum gain-frequency product, f_T, of 50 Mc/s, a maximum dissipation at 25°C of 2·5 W, or 10 W in a suitable heat sink.

Current and voltage ratings are as follows:

V_{CB} max.	Maximum collector-to-base voltage with emitter open-circuited, or reverse biased	40 V
V_{CE} max.	Maximum collector-to-emitter voltage with base open-circuited	20 V
V_{BE} max.	Maximum emitter-to-base reverse voltage	6 V
I_C max.	Maximum collector current	0·5 A
I_E max.	Maximum emitter current	0·6 A

The TK200A conforms to the following drawings:

VASCA: 50-5
K1007: A1/D4A
JEDEC: TO-3.

Sample quantities are available.

Circle **1** *for further details.*

Digital Volt Ohm Meter

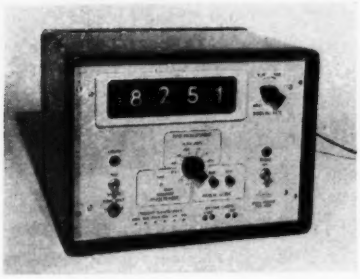
VENNER ELECTRONICS LTD. have produced a new fully transistorised digital volt ohm meter.

This instrument is capable of measuring d.c. and a.c. voltages from 1 mV to 1·1 kV, and resistance to 1·1 MΩ. The results are clearly displayed by four new in-line type projection indicators, with automatic sign indication, and may be recorded by direct coupling to a Venner printer and/or a reperforator control unit.

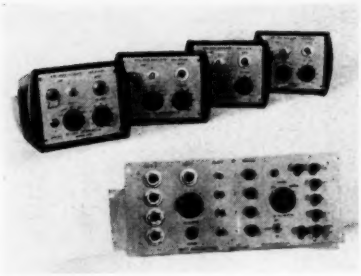
The meter performs many other digitisation functions, and is eminently suitable for operation as a single instrument, or for inclusion in any data logging system. It employs no stepping switches or relays, and consists of transistorised plug-in stages. It provides steady readings with fluctuating input, and is simple to operate. Price: £385.

Circle **2** *for further details.*

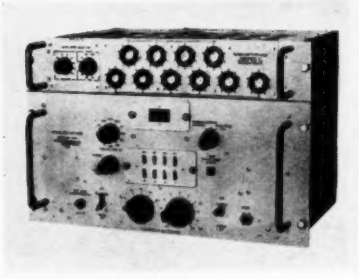
Digital volt ohm meter



100 kc/s counter



Switching panel



Timing unit fitted with scaling unit

100 kc/s Counter

SOUTHERN INSTRUMENTS' new 100 kc/s counter Type M1154 is a transistorised digital frequency and time interval meter.

Features of the instrument include a very high input impedance, latched display and simplicity of operation. The latching system retains the display of the previous count during the time a new count is being made. At the completion of this new count the totaliser is inspected, and the display is changed only if the new total differs from that already displayed.

A wide viewing angle is achieved with in-line indicators of the projection type, the black ground screen of which ensures good readability in high ambient light levels. Separate indicators show when a count has been completed and when the capacity of the totaliser has been exceeded. Simplicity of operation is achieved by the use of a single switch to select function and range.

Unknown frequencies between 0·1 c/s and 120 kc/s may be measured using count periods of 0·1, 1, or 10 seconds. The counting interval may also be controlled manually. Time intervals defined by electrical signals or contact closures can be measured in crystal controlled clock units of 0·1 ms to 10 secs, in decade steps, to a maximum of 10,000 units. The clock units are also available at outlet sockets on the front panel.

The instrument is mains operated, and is compact, portable and robust, making it equally suitable for laboratory and industrial applications.

Circle **3** *for further details.*

Switching Panel

THE switching panel, Type MR527, has been designed to replace the f.m. switching panel, Type MR517, in the Southern f.m. system for the display and measurement of transient physical phenomena on an oscillograph. The oscillator, Type M785, is being designed for use with this new panel.

Up to four oscillators, each of which is controlled by a single capacitance or inductance type transducer, may be connected to the MR527. This arrangement permits the recording system to be located very much further from the apparatus under test than was previously possible.

Controls are provided for reversal of signal polarity and variation of output amplitude for each channel independently. This facilitates immediate switching of any transducer output into the pre-amplifier, Type MR513, without resetting the controls. Provision is made for the insertion of degree marker pulses, the polarity of which is also preset for each channel.

Circle **4** *for further details.*

Timing Unit

THIS timing unit, Type N108, of Dynatron Radio Ltd., has been designed primarily to operate with the 1009 series of scaling units from which it can obtain its supplies. The main function of the unit is to switch the scaling unit off at either a pre-set time or a pre-set number of counts and to enable the count and time totals to be read from calibrated decade counting tubes.

The N108 timer has a maximum time store of 100,000 seconds and, when used in conjunction with scaler 1009, a maximum count store of 1,000,000 counts. A further advantage of the N108 is that it enables the scaler 1009 to be operated at its maximum resolution time of 1 microsecond thereby allowing the maximum counting rate of the scaler to be utilised, i.e., 200 kc/s per second.

Circle **5** *for further details.*

Electrophoresis Apparatus

THE increasing adoption of continuous, cellulose acetate and starch gel electrophoretic techniques is catered for by a series of EEL adaptors and units which are now available from the makers of the EEL electrophoresis apparatus, for use with their standard equipment. These ancillary devices consist of a continuous electrophoresis cabinet, a tray and slicer for starch gel samples, a tray for cellulose acetate strips, and a constant current power unit.

The continuous electrophoresis cabinet houses the electrophoretic curtain, reservoirs for the sample and buffer solutions, test tubes and capillary tubing, electrodes, etc.

The starch gel tray provides for the setting of a sample approx. 15 × 5 cm and 6 mm thick, which can be sliced into four layers, each 1·5 mm, by using the starch gel cutter which is an available extra.

The cellulose acetate tray will carry two strips each 2·5 cm wide, and an ingenious tensioning device ensures each strip being kept taut. An available extra is the scanner adaptor which enables the electrophoretic strips to be read and plotted with the standard scanner.

The power unit is a constant current instrument, with a maximum output of 50 mA, 600 volts, and is for use with continuous and starch gel electrophoresis.

Circle **6** *for further details.*

Germanium Gold-bonded Diodes

A RANGE of germanium gold-bonded diodes is being introduced for use in computer and switching circuits by Standard Telephones & Cables Ltd. Having a combination of high forward conductance, high reverse resistance and good switching characteristics, they are particularly suitable for these applications. An added advantage is their extremely small size.

Brief Characteristics

Type	Min. Forward Current at 1 V (mA)	Max. Reverse Current at −10 V (μA)	Max. Reverse Voltage Rating (V)
DK 10	75	3	25
DK 11	50	3	60
DK 12	50	3	100

The typical figure for charge storage with a forward current of 10 mA is 3 mμ coulomb.

Circle **7** *for further details.*

Thermoelectric Cooling Unit

THE first of a range of thermoelectric cooling units to be marketed by a British manufacturer has been introduced by Salford Electrical Instruments Ltd., following an extensive research programme at the G.E.C.'s Wembley laboratories.

Based on the Peltier effect, the cooling capacities of the units vary from less than 1 W for a single junction type to more than 10 W for a large multiple junction. They thus cover a range which cannot be conveniently dealt with by conventional means of refrigeration.

The first of the group to be readily available is Type BT.4, a four-junction unit with a cooling capacity rated nominally at 1 W, although the rating can be increased with a resultant reduction in temperature depression. Alternatively, a greater temperature depression can be achieved by reducing the rating.

The BT.4 is made in the shape of a small cube, and thermal junctions are formed by a combination of "p" and "n" types of a bismuth telluride semiconductor material. In use, the block is clamped between the object to be cooled and a heat sink. Typical of its many applications is the cooling of electronic components which must operate in high ambient temperatures, when it serves to increase the power ratings of transistors, reduce the dark current in phototransistors, or—in the case of quartz crystals—to allow operation at the inversion point or other selected part of the frequency deviation/temperature characteristic.

Other applications are with laboratory equipment such as microtome knives or microscopic slides where local cooling is essential; with instruments such as dew-point hygrometer heads where thermoelectric cooling involves changes in techniques and resultant simplification in the equipment; and with the cooling of small volumes by incorporating one or more units into the walls of a chamber. Here, the temperature may be held constant by a proportional controller which allows smooth regulation of the cooling rate via the d.c. current applied.

Circle **8** *for further details.*

Temperature Indicator-Controller

THE Störk Combistat contact thermometer, recently introduced on the British market by Charles Eley & Sons, should have many applications where a simple, inexpensive yet reliable temperature control is required.

The difference between the Störk Combistat and others previously available is that the hand-set pointer, adjustable over the whole scale, is coupled to a microswitch so that a circuit carrying up to 3 amperes at 230 volts can be made or broken.

The instrument is very neat in appearance with a narrow chromed bezel for panel mounting in a $2\frac{3}{8}$-in. hole.

Temperature ranges are those usual for a vapour-pressure thermometer and capillaries can be supplied up to 65 feet in length.

Circle **9** *for further details.*

Hand Embossing Tool

HELLERMANN LTD. have produced another version of the standard Dymo-mite hand embossing tool.

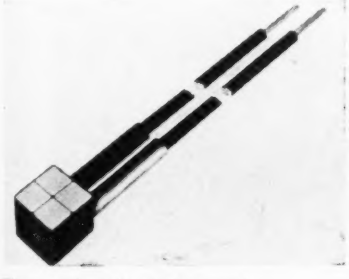
The new M3 tool has the additional facilities for punching holes in the ends of the embossed labels, as well as for rounding the labels' corners.

The standard range of Dymo-mite vinyl embossing tapes can now be supplied with a matt finish.

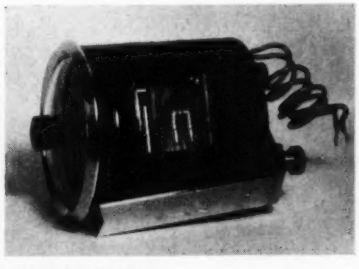
Also available are Dymo tapes in twin-colour schemes. The centre strip of the tape is produced in one colour, with the two edges in the second colour.

These colour combinations can be made up from any of the existing range of colours and apply, at the present time, to adhesive-backed tapes only.

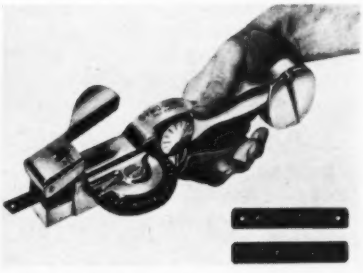
Circle **10** *for further details.*



Thermoelectric cooling unit



Störk Combistat



Hand embossing tool

Cop grading machine

Cop Grading Machine

A MACHINE for the automatic grading of cops is now being manufactured and marketed by Lancashire Dynamo Electronic Products Limited. The machine, developed by the Wool Industries Research Association, is designed to sort cops into six grades of weight as compared with a standard. The unit utilises electronic techniques to obtain and store information from an Avery "Shadoweight" scale operating a selector mechanism to divert the cops into the appropriate bins. In addition to the mechanical sorting operation, a series of display counters provide a visual indication of the numbers handled.

The grading machine rejects cops of excessively light or heavy "count", reducing the possibility of costly faults in subsequent processes. Grading speeds of up to 1,800 cops per hour can be achieved, depending on the pace of the operator. No special operating skill is needed as the machine is fully automatic once the cop has been placed on the grading pan.

Circle **11** *for further details.*

Backward Diodes

THE latest Standard Telephones & Cables' backward diode is the JK100C.

These devices, hitherto known as backward rectifiers, are available in sample quantities. The JK100C is a germanium type exhibiting resistance ratios which are voltage sensitive over a range from about 20 mV to 200 mV.

Used together with tunnel diodes, they have applications in computer and switching circuits. Further applications may be found in low-level rectification and meter protection.

Circle **12** *for further details.*

"Do-it-Yourself" Computer Components

ELECTRONIC ASSOCIATES LTD. is now offering a transistorised "do-it-yourself" special purpose analogue computer that will perform a variety of laboratory, engineering and process control computing tasks.

The introduction of the TR-5 mounting unit makes it possible for special-purpose analogue computers to be assembled easily and without the problems usually associated with such a project.

The unit contains all the controls necessary to operate a 20-amplifier computer. The basic unit will house up to six computing components and a fully-transistorised power supply. It may be expanded to large-computer capability by adding up to two expansion units to the basic rack.

One expansion unit, the TR-5-1, is prewired to accept an additional five dual transistorised amplifiers. Additional space is available, but not wired, for five more dual modules or ten single modules for the addition of assorted linear or non-linear computing components.

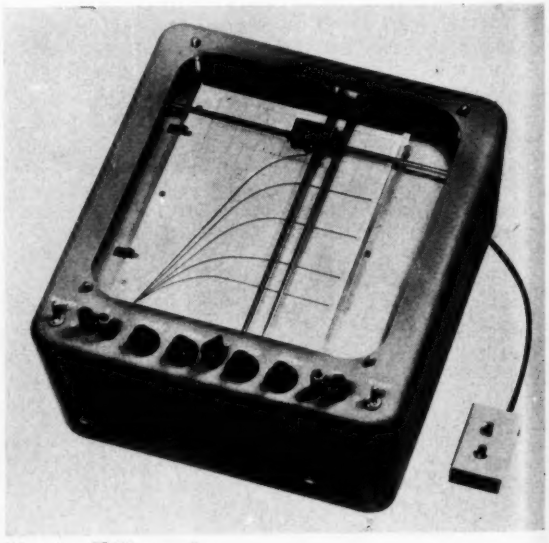
The other expansion unit, the TR-5-2, provides space for ten dual modules or twenty single modules which can be wired to accept any PACE solid state analogue computing component. Both expansion units are powered from the power supply located in the basic TR-5 mounting unit.

The basic TR-5 mounting unit, including ten amplifiers, power supply and reference regulator, is priced to sell for £1,186 10s. 0d. The expansion units are priced at £64 10s. 0d. and £32 0s. 0d. for the TR-5-1 and TR-5-2 respectively. Additional PACE solid state analogue computing components are available at prices ranging from £28 0s. 0d. to £185 10s. 0d.

Circle **13** *for further details.*

Point-plotting X-Y Recorder

THE new Houston Model HR-93 X-Y recorder incorporates an improved electric pen lift mechanism of simple and robust design allowing point plotting and family curve tracing. The pen lifter can be operated either manually using the push button control box or it can be designed into the test circuitry for automatic operation. The recorder can also be used for conventional full line curve tracing. Chart changing is also



Houston X-Y recorder

facilitated by means of a "Load-operate" switch which automatically lifts the pen and removes it away from the chart area; after loading the fresh chart the pen is held up so that no trace appears when the pen carriage returns to the original position. The recorder is simple in both operation and construction, using standard 8½ in. × 11 in. graph paper located on a flat bed. Each axis contains its own power supply, attenuator and zero control and is independent, both mechanically and electrically, of the other. Amplifiers are interchangeable in 10 mV/in. and 1 mV/in. sensitivity for either or both axes. The accuracy is within ±0·5% with 7·5 in./sec pen speed for both axes. Snap-on pen construction permits rapid interchange for various colour traces. The "straight-through" pen design facilitates quick cleaning and allows the use of washable fountain pen inks.

It is available from Scientific Furnishings Ltd.

Circle **14** *for further details.*

Flow Indicators for Opaque Liquids

THE problem of observing the flow of an opaque liquid through a pipeline has been overcome by Sir W. H. Bailey & Co. Ltd. by the introduction of a range of Magnetel flow indicators.

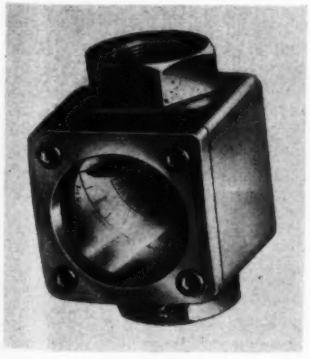
These instruments, which can be used with liquids of almost any viscosity—such as thick oils—are equally suitable for indicating flow either horizontally or vertically upwards.

As the fluid travels through the chamber of the indicator it moves a hinged metal flap which incorporates a built-in magnet to operate a pointer against a scale. As there are no springs or other moving parts, the risk of mechanical breakdown or jamming is eliminated, and the pointer and scale are in a separate chamber so that the fluid cannot obscure the window.

Internal parts of the Magnetel are readily accessible for cleaning while the body is still in the line, and can be turned through 90° if required to change the direction of flow.

A particular feature is that the Magnetel can be easily adapted for extremely low flow rates, and its sensitivity means that the smallest change in relative flow is shown against the scale. It will also accept a wide range of capacities when full flow is shown on the scale.

In situations where the liquid may contain ferrous particles which might adhere to the magnet a special screened Magnetel is available, in which the magnet is fully enclosed in an intermediate chamber.



Magnetel flow indicator

'Impressor' hardness tester

A switch model is also available so that when flow stops completely or falls below a certain rate, a switch is automatically operated to give a reinforcing audible indication of an emergency.

The Magnetel is available in standard ½ in., ¾ in., 1 in. and 1½ in. sizes, with ends screwed B.S.P.T., with adaptors to match ⅜ in. and 1¼ in. The 2 in. size has flanged ends.

Standard sizes are available ex-stock, other models on short delivery.

Circle **15** *for further details.*

Hardness Testing Instrument

THE Impressor hardness tester is a portable instrument, available in three models, to cover plastics, soft metals such as aluminium and its alloys, brass and copper, etc., also extremely soft materials such as lead, linoleum and leather, etc. It has been designed for use on fabricated parts as well as on raw materials.

Simple in operation, it is only necessary to exert a light pressure against the instrument to drive the spring-loaded indenter into the material under test, the hardness reading being instantly indicated on a dial which is conveniently divided into one hundred graduations.

The instrument indicates relative hardness rather than a specific hardness according to any of the recognised scales, although its reading can be approximately related to standard scales and this is shown in the available literature.

The Impressor is manufactured by the Barber-Colman Co. of U.S.A. and is distributed in Gt. Britain by Industrial Instrument Services Co.

Circle **16** *for further details.*

Sub-miniature Feedthrough

ANOTHER "Press-Fit" unit is added to the range of Teflon-insulated terminals offered by the Sealectro Corp. This is the Type FT-SM-16L6, Feedthrough.

The significant feature of the new FT-SM-16L6 is the extra-long pin, permitting extra "reach" combined with a small diameter Teflon body for space-saving on the mounting chassis. The overall length is 0·987 in. while the Teflon body is 0·093 in. diameter through-chassis, and 0·125 in. diameter through mounting shoulder. The unit is designed for use with chassis having a maximum thickness of 0·060 in.

Circle **17** *for further details.*

Polarograph

THE Tinsley polarograph Mark 200, manufactured by Evershed & Vignoles Ltd., is designed for both research and industrial requirements. Its field of application covers investigations into electro-chemistry, stability constants of reducible compounds and characterisation of certain complex organic materials. It is an accurate and sensitive analytical tool capable of trace determination of materials in solution to better than 0·02 p.p.m.

The d.c. circuit employed permits its operation from any type of electrode system. The electrode may be positive or negative with respect to the reference electrode.

The instrument embodies a newly designed galvanometer transistor d.c. amplifier which uses two parallel feedback circuits to adjust sensitivity in one feedback loop and speed of response in the other.

The recorder on which the final polarograms appear presents the trace on a horizontal table on which the operator may write the relevant experimental data conveniently. The indicators for voltage and sensitivity are arranged at eye level and can be scanned at a glance whilst the controls, which are kept at the same setting throughout a series of experiments, are arranged below the recorder table.

The potentiometric recorder itself has an effective chart width of 200 mm allied to a response time of 1 second and embodies its own integral amplifier. Two chart speeds are provided. The overall sensitivity of the polarograph covers from 0·02-100 microamp for full-scale deflection.

A particularly interesting new feature is the provision of a peak reading unit which eliminates capacity current noise and thus permits the chemist to obtain virtually undamped polarograms at all sensitivities without loss of resolution on both direct and derivative polarograms. Conventional damped polarograms may also be recorded (derivative type damping is used), and little or no zero shift will occur either with direct or derivative polarography. The potentiometer covers a voltage span from +0·5-3 and reverse with 5 scanning speeds for increased resolution.

The new polarograph is housed in a metal case and makes use throughout of transistorised circuitry and printed circuits arranged in plug-in units to facilitate servicing and maintenance.

The potentiometric recorder may also be used as a recording microammeter over its working range, without modification as suitable switching is provided.

Circle **18** *for further details.*

Wander Plug and Socket

A NEW Clix miniature wander plug and socket, particularly suited to printed circuit mounting, is introduced by the Radio Components and Special Products Department, A.E.I. Radio and Electronic Components Division.

Socket mounting pin diameter is 0·050 in., conforming to the 0·1 in. module printed circuit technique, and the socket can be mounted on a 0·2 in. centre using the standard nominal 0·050 diameter mounting hole. Overall diameter of the socket body is 0·19 in., pin length is $\frac{7}{64}$ in., and body length $\frac{11}{32}$ in.

Overall diameter of the plug is 0·19 in., pin diameter is 0·04 in., pin length $\frac{1}{4}$ in., and body length $\frac{9}{16}$ in.

Metal parts are brass, silver-plated, and the insulation is nylon. Standard colours are red or black, but other colours can be supplied against special order.

Circle **19** *for further details.*

"Press-Fit" Midget Standoff Terminal

A MIDGET standoff terminal for miniaturised assemblies is now offered by Sealectro Corporation. The new RST-SM-31TUR-L2 features a turret stud with Teflon body for "Press-Fit" installation technique. Overall length of the new unit is 0·296 in., while the soldering lug measures 0·156 in. long. The through-chassis Teflon body is 0·148 in. diameter, with a 0·172 in. diameter shoulder for chassis support. The solder lug is made of brass. The new terminal is available in all standard EIA colours for circuitry coding.

Circle **20** *for further details.*

Plastic Precision Potentiometer

A NEW range of conductive plastic precision potentiometers is now available for the first time in the United Kingdom from Scientific Furnishings Ltd. These potentiometers have been developed in U.S.A., by Ace Electronic Associates, Inc., and employ a special moulding technique which eliminates the possibility of sudden failure and incorporates a homogeneous conductive plastic resistance element. The life expectancy is greater than 20 million cycles and the potentiometers are resistant to shock, vibration and acceleration. A feature of the design is the extremely low operational noise—less than 25 ohms at 1 kΩ and 50 ohms at 100 kΩ. The standard linearity is 0·5% but can be up to 0·1% to special order. A wide resistance range has been achieved—from 100 ohms up to 250 k ohms for the $1\frac{5}{16}$ in. diameter and 100 ohms to 150 k ohms for the $\frac{1}{2}$ in. diameter. The torque is down to 0·1 in. oz starting. The units known as the Acemho range are completely sealed against foreign matter in the environment and conform to all applicable services specifications.

Circle **21** *for further details.*

High-speed Mesa Switching Transistors

THE two new RCA n-p-n silicon types—RCA-2N706 and RCA-2N706-A—are additions to their range of high-speed, diffused-junction mesa transistors. The new RCA p-n-p germanium mesa type—RCA-2N1683—is similar in design to the RCA-2N1300 and 2N1301 but offers improved high-speed performance.

RCA-2N706

Storage time	60 musec (max.) at I_c = 10 mA
Gain-bandwidth product	400 Mc/s (typical)
Minimum beta ...	20
Dissipation	1 watt at 25°C

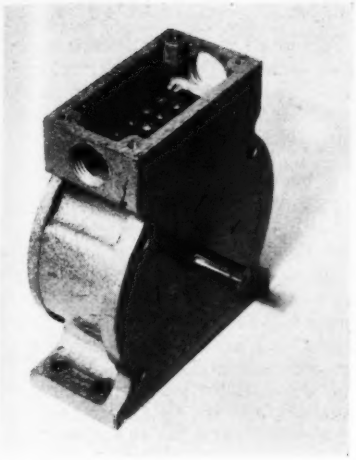
RCA-2N706-A

25 musec (max.) at I_c = 10 mA

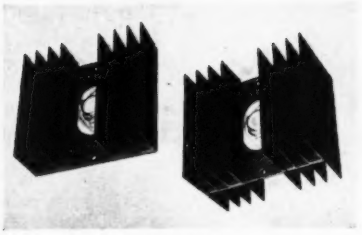
RCA-2N1683

Total stored charge ...	410 μμ coulombs (max.) at I_c = −40 mA
Gain-bandwidth product	80 Mc/s (typical) at I_c = −10 mA and V_{CE} = −3 volts
Beta	85 (typical) at I_c = −40 mA
Dissipation	150 milliwatts at 25°C

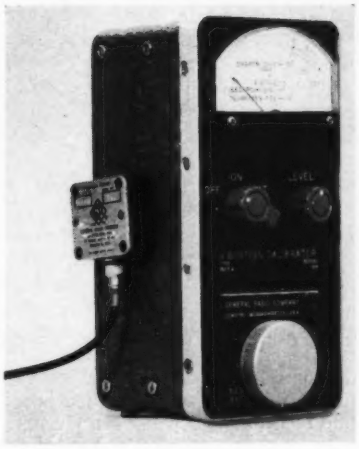
Circle **22** *for further details.*



High-speed impulse switch



Heat sinks



Vibration pick-up calibrator

High-speed Impulse Switch

A NEW electro-mechanical switching unit has been introduced by Lancashire Dynamo Electronic Products (Components Division) which is designed to provide electrical circuit switching from the rotation of a shaft by means of cam-operated heavy-duty switches.

The housing is splash-proof and is of cast light alloy construction, being finished in hammer grey. Mounting is either by foot or by flange, both being integral parts of the housing. The switch is driven by a $\frac{3}{8}$ in. diameter input shaft which is supported in a sealed bearing at each end of the assembly. Two sets of heavy-duty leaf spring contacts are included and the operation is determined by the form of the cam.

The rotary switch is primarily intended for use with the series F43 high-speed electromagnetic counter unit, but with an alternative cam-form the unit is particularly suited to limit switching on rotary valve actuators and similar applications.

Circle **23** *for further details.*

Heat Sinks

THE increasingly wide usage of power transistors and related semiconductor devices in the many fields of electronic engineering has made necessary the provision of effective but inexpensive means of cooling. To cater for this need, Marston Excelsior Ltd., whose work for the electronics industry has been concentrated on specialised heat exchangers for airborne equipment, has now designed standard heat sinks cooled by natural air convection. Limited quantities of two models are now available. Model 1, with sixteen fins, has a nominal thermal resistance of $1\frac{3}{4}$°C/watt and Model 2, having eight fins, $2\frac{1}{2}$°C/watt, in free air.

These coolers have been extensively tested under a variety of different conditions.

Circle **24** *for further details.*

Calibrator for Vibration Pickups

A COMPACT battery-operated vibration calibrator (Type 1557-A), with which one can calibrate accelerometers, vibration pickups and vibration meters, as well as other vibration-measurement systems that use small, crystal-type accelerometers as sensing elements, has been announced by the General Radio Company, and is available in the U.K. from Claude Lyons Ltd.

Consisting of a transistorised electromechanical oscillator and a battery-operated cylindrical shaker, the instrument provides a standard acceleration for 1 *g* (r.m.s.) at 100 c/s. Acceleration output appears at two pillbox-shaped 50-gramme discs mounted on an internal cylinder extending through the instrument and projecting at the sides. The pickup to be calibrated is attached to, or in place of, one of these discs. Acceleration accuracy is $\pm 10\%$; frequency accuracy is $\pm 1\%$.

Oscillator amplitude can be adjusted by a panel level control, and in this way the calibrator is adapted to pickups of different masses. To subject a pickup to an acceleration of 1 *g* at 100 c/s, the level control is adjusted until the panel meter, calibrated in grammes, indicates the mass of the pickup. The only other control on the instrument is a combination on-off switch and battery checker.

Power is supplied by four RM-Y mercury cells, whose life is 100 hours.

The total weight of the instrument, including a leather carrying case, is 1·5 kg. Dimensions are 102 × 204 × 102 mm.

Circle **25** *for further details.*

Emitape Accessory Kit

TAPE-RECORDING enthusiasts can now use in their own homes the professional equipment necessary for precision cutting and fumble-free splicing. The new Emitape accessory kit provides in compact and immediately accessible form the facilities for editing magnetic recording tape that are normally found in broadcasting and recording studios.

Mounted on a specially-moulded plastic tray with a rack for seven reels, the kit comprises an Edi-tall detachable metal joining block slotted for 90° and 45° cuts, two razor-sharp cutters, three reels of leader tape, a reel of metallic stop foil, and a reel of jointing tape. Each reel of tape or foil is both protected and held vertically ready for pulling in a neat and practical Emicase dispenser of red polystyrene.

The tray is drilled for easy fixing to a workbench or table, dual-purpose wood/metal screws being provided with the kit.

The price of the complete accessory kit, with instruction booklet, is 37s. 6d.

Circle **26** *for further details.*

New Modules for Technicon AutoAnalyzer

A TWO-SPEED proportioning pump and an automatic sampler of greater capacity that extend the scope of laboratory applications for the AutoAnalyzer have been developed by Technicon Instruments Company Ltd.

The Technicon AutoAnalyzer, available in laboratory and plant models, is a continuous flow system that enables each step of a chemical analysis now performed manually to be performed automatically, including measuring, mixing, purifying, processing, comparing and recording. Because sample size, time and temperature remain constant, reproducible results can be obtained down to parts per thousand million with a precision of $\pm 1\%$. Since the instrument checks the sample to be analysed against a continuous stream of standard sample, the process is self-correcting.

Until now automation of laboratory procedures was practical only for large numbers of repetitive tests as each test series required long set-up time. With the advent of the AutoAnalyzer's two-speed proportioning pump, set-up time between test series is reduced to as little as one minute.

The two-speed proportioning pump provides the operator with a choice of standard-speed or high-speed flow equal to $4\frac{1}{2}$-times standard speed. This makes it practical to run as many as ten or twelve different analyses daily on the same machine with minimum changeover. This feature is of great advantage to small laboratories which run a great variety of tests for a small number of samples of each.

The new sampler holds 200 test-tubes of 30 ml volume on an automatic, self-revolving rack, making it possible to test-run the AutoAnalyzer for more than 30 hours with one rack-loading. The machine can be set at the end of a work day and will continue to operate overnight, unattended, providing 200 analytic results the following morning. The sampler is equipped with two timers—one controlling a selective aspiration period, the other the total cycle-time. The system is cleansed during the difference between the two timer settings.

Techniques developed for low-level analyses, hitherto limited to monitoring applications in view of large sample volume required, can now be employed in laboratory work with the AutoAnalyzer.

Circle **27** *for further details.*

Brake Bonding Adhesive

CIBA (A.R.L.) LIMITED announce the addition of Redux 68 to their range of brake bonding adhesives. Redux 68 has been specially developed for bonding all types of friction materials to operate at bond line temperatures over 350°C. Redux 68 is also capable of filling a gap of up to 0·05 in. between components without appreciable reduction in strength.

Circle **28** *for further details.*

The Fluroprint

THE Hilger & Watts Fluroprint is a new fully-automatic X-ray fluorescence spectrometer. It has been developed to analyse materials rapidly in a flexible routine. Particular aims in designing the instrument were ease in changing from one analytical programme to another, high accuracy and sensitivity, and simplicity and reliability in operation.

The Fluroprint will deal with any element having an atomic number of 12 (magnesium) or higher, and will analyse up to twenty elements in one operation. The instrument scans through the spectrum, and is programmed to stop at the appropriate angle for each element. The spectrometer is completely evacuated.

The Fluroprint works on a ratio system and pulses are counted during the accumulation of a pre-set number of counts on the monitor. Scintillation and flow proportional counters are arranged to cover the whole range of an analysis, and no adjustment is needed. To change from one type of analysis to another it is only necessary to pull out the plug-board and substitute another covering the required programme.

An electric typewriter automatically prints the results obtained from the line intensities, and interpretation is rapid and straightforward.

Circle **29** *for further details.*

Solid Tantalum Capacitors

TEXAS INSTRUMENTS LTD. of Bedford announce the availability of solid tantalum electrolytic capacitors. These "tan-TI-cap" capacitors are specially designed, processed and tested to meet military and industrial requirements. Type SCM "tan-TI-cap" capacitors are available in 203 standard capacity-voltage combinations ranging from 1 to 330 µF $\pm 10\%$ and $\pm 20\%$ tolerance, and in standard voltage classes of 6, 10, 15, 20, 25 and 35 d.c. working voltage. They are built in four case sizes.

Performance specifications give rated voltage operation at -55 to $+85$°C and two-thirds rated voltage at 125°C with stable operation from -80 to $+125$°C. These capacitors are guaranteed to have a failure rate better than 2×10^{-5} when run at maximum rating.

Other features of the Type SCM "tan-TI-cap" capacitors include, subminiature industrial standard case sizes, a continuous reverse voltage capability, high vibration and shock resistance and a highly corrosion-resistant finish. Supported axial leads without external seals permit ease of mounting and can be sharply bent without breaking.

Type SCM capacitors are of the solid electrolyte, sintered tantalum anode construction which utilises a tantalum pentoxide dielectric film of high integrity and maximum thickness for each of the industrial voltage classes of 6, 10, 15, 20 and 35 d.c. working volts. This construction ensures that "tan-TI-cap" capacitors retain their original characteristics over indefinitely long periods of shelf life as they can neither leak, dehydrate nor be affected by temperature.

Controlled deposition of the manganese dioxide semiconductor electrolyte plus the high-purity carbon and high-conductance negative counter electrode assures high penetration, and good electrical contact, and conformance with a maximum 6% dissipation factor.

Circle **30** *for further details.*

Twin-plate Tetrode

THE RCA-6FA7 is a new diode—sharp-cutoff twin-plate tetrode of the 9-pin miniature type. This tube, formerly known by its developmental number A-5996, is particularly useful in frequency-divider and complex wave generator circuits of electronic musical instruments.

The diode unit and the tetrode unit utilise a single cathode. The twin plates of the tetrode unit are on opposite sides of the cathode. This arrangement minimises interaction between the electron streams from the cathode to each plate. Each tetrode plate has a maximum dissipation rating of 1·5 watts.

Circle **31** *for further details.*

Power Pentode

THE 35EH5 is a power pentode of the 7-pin miniature type. It is intended for use particularly in the audio-output stages of f.m. or a.m./f.m. radio receivers and audio-amplifier systems operating from transformerless a.c. or a.c./d.c. power supplies.

Two 35EH5's together with the Types 12AX7 and 35W4 can comprise the entire tube complement of a stereo-amplifier system using series-connected heaters.

The 35EH5 features high power sensitivity, and is capable of providing relatively high power output at low plate and screen supply voltages and low driving voltages. For example, in class A1 amplifier service, a single 35EH5 can deliver a maximum-signal power output of 1·2 watts operating with a plate supply voltage of 110 volts, grid-No. 2 supply voltage of 115 volts, and a peak-a.f. grid-No. 1 voltage of only 3 volts.

It is obtainable through R.C.A. (Great Britain) Ltd.

Circle **32** *for further details.*

Electronic Inflammable Gas Detector

IN the I.E.C.-Sieger electronic gas detector, catalysts are impregnated in an insulating material which is heated by a wire coil, part of a balanced circuit. Similar insulating material and coils form, with the detector lead, the other arm of the circuit. Wires so supported resist vibration, accidental damage and burn-out.

These catalysts react to inflammable gas by increasing the temperature and electrical resistance of the coils thereby unbalancing the bridge. Ambient temperature changes affect both wires equally and the circuit remains balanced.

Electrical unbalance caused by a gas is amplified by a transistor in a special feedback circuit which operates a relay and the dual alarm system. Because several catalysts are combined in the I.E.C.-Sieger detector, it is sensitive to all inflammable gases and consumes less than ½-ampere. Concentrations of gas are less likely to fuse the wire—as occurs with platinum.

The dual alarm system is reliable and foolproof. The green indicator lamp is connected in series with the detector circuits and will not light up if these are broken. The signal lamps have a normal life of 1,000 hours but the green lamp is under-run by 20% and its actual life is much longer. Electrical contacts, housed in the spray and corrosion-proof control box, are protected from the effects of continued use in corrosive atmosphere.

The detector head of corrosion resistant alloy is suitable for ambient temperatures up to 300°F (approx. 150°C). Three layers of stainless steel Monel flameproof gauze enclose the sensitive elements, preventing flashback. Cable connections to the head are sealed against corrosion by "Araldite". Its sensitivity is unaffected by pressure changes.

Circle **33** *for further details.*

Silicon Alloy Junction Transistors

MULLARD announce that the OC205 and OC206, their new medium-power silicon alloy junction transistors, first introduced earlier this year, are now in full production.

Both these devices have a peak current rating of 0·5 A, and have a maximum junction temperature rating of 150°C.

The junction temperature rating permits a dissipation of 300 mW at 25°C. Higher dissipations are possible if a heat sink is used.

The OC206 has been introduced for general purpose applications where a very high large signal current gain is required to reduce the number of transistors used in a circuit. Its typical large signal current gain is 40 at a collector current of 30 mA and even at 300 mA the typical gain is 15.

The cut-off frequency (f_1) of the OC206 is 2 Mc/s. Voltage ratings are −32 V collector-base and −24 V collector-emitter.

The OC205 has the high maximum voltage rating of −60 V both for collector-base and collector-emitter at collector currents of up to 200 mA. The device is thus particularly useful for telephone exchanges and many kinds of mobile equipments.

The cut-off frequency (f_1) of the OC205 is 1·5 Mc/s and its typical large signal current gain is 24 at a collector current of 30 mA.

Both the OC205 and OC206 have the low leakage current and low collector bottoming voltage which are characteristic of silicon alloy junction devices. They thus obviate the need for severe d.c. stabilisation against thermal runaway, so simplifying the associated circuitry.

Both devices have metal cans, the dimensions of which are 15·7 mm × 5·9 mm.

The OC204, a silicon alloy junction general purpose transistor of the p-n-p type, introduced last year with a peak current rating of 0·25 A, has now been uprated to 0·5 A.

The voltage ratings of −32 V collector-base and −24 V collector-emitter are identical with those of the OC206; the current gain of 24 at 30 mA is the same as that of the OC205.

Circle **34** *for further details.*

Automatic L.F. Sweep Oscillator

THE Type 444 automatic l.f. sweep oscillator from Dawe Instruments fills the need for a low distortion resistance-capacitance tuned oscillator covering 5 c/s to 5,000 c/s, in a single range. The oscillator provides constant voltage output and the frequency scale calibration is truly logarithmic. The frequency sweep control is driven by a self-contained motor arranged to give various sweep rates between any desired frequency

limits. The direction of frequency sweep can be set to reverse automatically at the limiting frequencies. Alternatively it can be reversed or the sweep stopped at any instant by remote control. This feature is of particular value in resonance search testing since the oscillator can be permanently installed with the other vibration control equipment and remotely tuned by the operator examining the part being tested on the vibration generator.

The equipment is designed to drive a power amplifier and moving coil generator for vibration resonance search and endurance test as required in component and equipment specifications, including British Standards B.S.2011:1954 and G100, Inter-Service Specifications R.C.S.11, DEF-5011 and K.114 and the International I.E.C. Publication No. 68.

Essentially the circuit consists of a frequency controlling bridge feeding a balanced push-pull amplifier with a cathode-follower output.

The frequency controlling network consists of a modified form of Wien bridge in which the resistive arms have been replaced by complex resistance-capacitance networks. These extend the constant phase shift frequency range over a ratio of 1,000 : 1 with a 10 : 1 capacitance ratio of the tuning capacitor. The tuning capacitor has a rotor shaft which can turn continuously and has been specially designed to provide a truly logarithmic scale calibration.

The instrument is mains operated and arranged for 19 in. relay rack mounting.

Circle **35** *for further details.*

Improved Tunnel Diodes

IBM have a greatly improved tunnel diode, which switches at speeds faster than $\frac{4}{10}$ billionths of a second. Basic computer circuits, such as binary triggers, can now operate 5 to 10 times as fast as previously designed units. The new diode will require considerably less power than would present units in comparable circuits.

A second new tunnel diode, in an earlier experimental stage, promises to play a useful part in computer storage circuits.

The key to the design improvements in both the new devices is a new fabrication method which involves an electronically monitored, and controlled etching technique. This automatic process takes place after a pellet of germanium has undergone its basic device packaging and assures uniform electrical characteristics in every unit. In the process the germanium (used for both of the new diodes) is etched away until an almost microscopic pyramid remains.

Two novel packaging concepts are used: one is called a "rivet" package, the other a "micro-wedge" package. Both packages provide good structural support to the diode's fragile junction which is smaller than 1/2000th of an inch wide and, at the same time, contribute to the improved electrical characteristics.

Circle **36** *for further details.*

Diesel Generator Control Panel

THIS is a mains failure generator control panel and is designed to work with a diesel generator set to provide continuity of supply for essential services such as hospitals, theatres, communication centres and industries where a failure of mains supply at any time may lead to severe inconvenience, danger, and loss of production time.

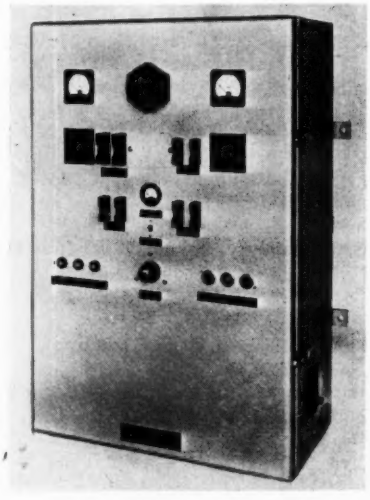
The Sicon control panel is designed to provide a starting signal to a diesel engine prime mover after sensing a complete loss or partial reduction of mains voltage.

The mains supply is automatically isolated from the load and the alternator connection made to the load after the voltage has built up to the required value and frequency. On restoration of supply from the mains, allowing also for transient restorations, the load is disconnected from the alternator and reconnected to the incoming supply and the engine is automatically stopped.

Provision is made for local control so that the engine may be exercised for maintenance purposes. Fault indicators and alarms to register engine defects such as failure to start, excessive engine temperature, or low lubricating oil pressure, are fitted as required. A battery trickle charger is usually included.

The control panel is available from Southern Instruments Ltd.

Circle **37** *for further details.*



Mains failure generator control panel

Industrial Silicon Mesa Transistors

FOR industrial and military applications in the 30 Mc/s to 250 Mc/s range, RCA announces three new n-p-n high-frequency medium-power transistors—2N1491, 2N1492, and 2N1493.

Designed for oscillator, driver, and large-signal power-amplifier service, these new high-frequency types, formerly known by their developmental numbers as the TA-1863, TA-1883 and TA-1951, respectively, can provide a minimum useful power output of $\frac{1}{2}$ watt at 70 Mc/s.

Types 2N1492 and 2N1493 are capable of delivering a power output of 10 milliwatts at 250 Mc/s with a typical power gain of 6·5 dB.

Capable of operating over a wide range of ambient temperatures from —65 to +175°C, these new silicon mesa transistors have the following characteristics:

	Type 2N1491	*Type* 2N1492	*Type* 2N1493
Collector-to-Base Voltage Rating	30	60	100 volts
Transistor-Dissipation Rating:			
In free air at 25°C ...	0·5	0·5	0·5 watt
With heat sink at 25°C	3	3	3 watts
Alpha-Cutoff Frequency:			
At I_C=15 mA ...	250	275	300 Mc/s
Power Gain:			
At 70 Mc/s:			
Up to 10 mW ...	13	—	— min. dB
Up to 100 mW ...	—	13	— min. dB
Up to 500 mW ...	—	—	10 min. dB

Circle **38** *for further details.*

Radiation Warning Tapes

CONTINENTAL DISTRIBUTORS LTD. have now available radiation warning tapes. These are in the form of a continuous roll of cellulose tape.

Type C.D.1 is supplied in 72 yard rolls, approximately 850 labels per roll.

The price is 18s. 6d. per roll.

Type C.D.2 is supplied in 18 yard rolls, approximately 420 labels per roll.

This label will take notes made with ball-point pen or pencil.

The price is 7s. 0d. per roll.

A convenient plastic dispenser is available to take either of the above, price 5s. 6d.

Circle **39** *for further details.*

4,000°F Temperature Elements

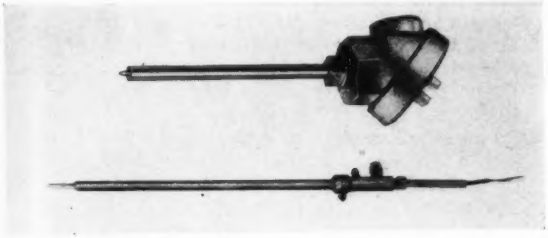
ALVERSTON INTERESTS are now able to supply Aero Research Instrument Co. (Chicago, U.S.A.) high temperature elements.

Aero Research has developed a complete line of thermocouple type temperature elements for use up to 4,000°F.

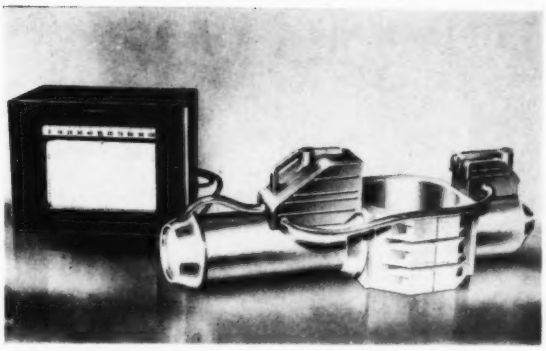
These are of the non-cooled and cooled types to measure liquid, solid and gaseous temperatures. Some of the elements are usable in oxidising atmosphere up to 4,000°F and intermittently higher.

The high temperature application is accomplished by the use of refractory metals, i.e., tantalum and molybdenum with special CR oxidation resistant coatings. The insulation is magnesia and beryllia and thermocouple wires are iridium, tungsten, rhenium and alloys of these elements.

Circle **40** *for further details.*



Aero Research thermocouples



Nucleonic density gauge

Density Gauge

THE new density gauge of Saunders-Roe and Nuclear Enterprises is of the nucleonic pattern. It involves a source comprising a radioisotope—Caesium 137 in this case—emitting gamma radiation. This is placed on one side of a pipe through which flows the material whose density is to be determined. On the opposite side is situated a photomultiplier acting as a radiation detector. The intensity of radiation reaching the detector is dependent on the density of material in the pipe. The use of a photomultiplier in place of an ionisation chamber greatly improves the sensitivity of the gauge. The photomultiplier signal is fed to a Honeywell Controls recorder with facilities for suppressed zero and span variation.

A complete automatic standardisation system is incorporated in the recorder. The measuring source is "switched off" and a calibrating source "switched on" for one minute at 10 minute intervals. This calibration source, which is mounted in a known and constant relationship to the scintillation counter, produces a fixed dose rate at the counter which automatically compensates for decay in the measuring source.

The signal produced by this dose rate is supplied to the recorder and the overall Wheatstone bridge sensitivity (i.e., both zero suppression and span) is adjusted automatically.

The overall calibration of the system in terms of the standard dose rate is independent of E.H.T. and temperature variation. In the standard model with the interval between calibrations of 10 minutes and the time of calibration 1 minute the response time is 10 seconds.

Accuracy of recalibration on the standard model is 0·05% and the statistical width (2 probable errors) 0·05%. Under normal conditions of installation a drift rate of less than 0·05% per 10 minutes can be achieved, giving an overall accuracy, i.e., least detectable change in signal and reproducibility, of 0·1% at a standard response time of 10 seconds. Response times will affect statistical accuracies and can be varied from 1 to 100 seconds.

Other models are available—one of high sensitivity capable of accuracies of the order of 0·01% and a small version designed to use with pipes in the range ½ in. to 4 in. in diameter.

Circle **41** *for further details.*

Computer Diodes

A NEW ultra-fast gold-bonded silicon diode with a guaranteed recovery time of half a nanosecond is now being produced by the Semiconductor Division of Hughes Aircraft Company in the U.S.A. These will be available from Hughes International (U.K.) Ltd.

The diode can switch and recover so fast its actual storage time cannot be measured on the finest laboratory travelling wave oscilloscope. The guaranteed recovery time of 0·5 nanoseconds is given only to accommodate the measuring limits of standard sampling oscilloscopes.

In development tests the Hughes computer diode switched from ten milliamps forward current to minus six volts reverse voltage with less than 0·2 nanoseconds recovery time. Typical capacitance for the total diode is 0·7 pF. It also has a rectification efficiency of 25% at 13·5 kMc/s.

Five diode types are being offered in the standard Hughes miniature glass package.

Circle **42** *for further details.*

Confidence Test Equipment

THIS equipment has been designed for confidence testing of submerged repeaters of the type inserted at regular intervals along the route of a submarine telephone cable, by the Electrical Measurement Division of Elliott Brothers (London) Limited, to the specifications of Submarine Cables Limited. The function of the test set is to monitor repeater gain continuously for several months in the factory before a repeater is accepted as being satisfactory.

One 7 ft rack of equipment provides facilities for testing up to three repeaters simultaneously. Two-way repeaters may be tested in the "high" or "low" frequency band by an arrangement of coaxial links.

Differential monitor units compare a test signal, at the output of a repeater, with a signal from the same oscillator (on a separate control rack) arranged to be at the correct amplitude by means of the attenuator units. Recording decibel meters, fed from a difference signal obtained from the monitor units, are used to obtain a continuous record of repeater performance.

Any repeater fault is indicated by at least two monitors, thus greatly reducing the chance of false readings due to monitor faults.

The repeaters are powered via power separation filters provided on the rack.

Circle **43** *for further details.*

Water Radioactivity Monitor

THIS equipment, developed by Elliott Nucleonics Ltd., measures and records the activity of solid radioisotopes dissolved in water. The sensitivity is such that a specific activity for drinking water well below the maximum permissible level for mixed fission products can be detected.

The monitor consists of a sampling unit and an indicating unit. The sampling unit contains a Geiger-Müller tube surrounded by a bed of ion exchange resin. Water is passed through the resin bed at a controlled rate and dissolved solids, including any fission products present, are retained in the resin.

The beta gamma activity emitted by the solid radioisotopes are detected by the Geiger-Müller tube. The output from the tube is fed to an indicator unit which records continuously the mean counting rate and, if required, actuates an alarm on reaching a pre-determined level. The measuring circuits employ transistors ensuring a high degree of reliability.

The sampling is normally carried out over a weekly period in which 20 litres of water are passed through the ion exchange resin at a controlled rate, after which the resin is replaced.

The Sampling Unit

The Geiger-Müller tube is of a specially designed thin wall beta-gamma halogen quenched type. This tube has a very stable characteristic.

It is mounted in a Perspex tube forming the measuring chamber which also contains the ion exchange resin. The resin is supported on a disc of fine stainless steel gauge and thus surrounds the Geiger tube.

With this arrangement and without shielding the background count should in normal surroundings be less than 30 c/m. A $\frac{3}{4}$-in. thick lead shield fitted around the Perspex tube may be employed to reduce the level to less than 20 c/m.

For purging the tube, mains water is connected and the resin removed by means of jets of water which eject it through a waste pipe for later disposal. The unit is charged with resin through the upper chamber. Push-button controls actuate both operations.

The introduction of water into the upper chamber is via a needle valve to allow for prevailing pressure conditions and permits a constant head to be maintained.

The flow of sampling water to the measuring chamber is controlled by an electrically-operated timing mechanism in conjunction with a variable throttle valve.

The Indicating Unit

The pulses from the Geiger tube are inverted and shaped in a pre-amplifier unit and fed to the ratemeter which provides an output proportional to the counting rate averaged over about 10 minutes. E.H.T. for the Geiger tube is generated in the pre-amplifier sub-unit.

The average counting rate is continuously recorded and an additional sub-unit may be included which actuates an alarm when a pre-determined count rate is reached.

The indicating system is housed in a metal cabinet with access to the recorder, controls and connections by means of a glass panelled door.

In order to reduce the inoperative time due to the long time constant on start-up, a calibration switch is included which brings the output reading to a predetermined level close to the actual count rate.

The following are brief particulars:

Recorder:	Graphic type 0-1 mA, scaled 0-50 counts per min
Response time:	10 minutes
Power requirements:	100-120 V or 200-250 V, 50 c/s, single-phase at 50 VA
Overall dimensions of cabinet:	17 in. high by $9\frac{1}{2}$ in. wide by $12\frac{5}{8}$ in. deep
Alarm count rate:	Adjustable over full range up to 50 counts per minute

Alarm contacts: One changeover rated at 1 A, 50 V d.c.

Sensitivity

The average background count with the lead shield is about 20 counts per minute.

Circle **44** *for further details.*

Pneumatic Thrusters

THE diaphragm model unites a large pressure power to small dimensions. The stroke varies between 1·181 and 1·968 in. By using the lever arm the movement can be increased.

The thruster is made of grey painted steel sheet. Between two gables, 1 and 3, there is stretched a diaphragm, 2, of a special toughened oil-resistant plastic. Under the diaphragm is the piston, 4, with the piston rod, threaded at the lower end. The casing, 6, encloses a return spring, 7. The piston rod is guided by the sleeve, 8. This sleeve is threaded externally to facilitate bolting of the thruster to any desired anchorage. The lubricator, 10, allows for the oiling of the piston rod.

When compressed air is released into inlet, 9, the diaphragm and the piston rod are pressed downward to the limit of the stroke. On releasing the air pressure the diaphragm is returned to its original position by the spring, 7.

Air line pressure is 80-90 p.s.i.

Thrusts up to 5,500 lb may be obtained. Thrusters with a maximum pressure power of 660 lb at an air line pressure of 6 atmospheres are also produced with a cylindrical case and a longer stroke than the diaphragm model.

The case of the cylindrical thruster is manufactured of steel sheet and painted grey. It consists of a lid, 1, and a spring case, 2, which are assembled by means of two half-circle shaped round bars, 3.

Inside the case is the piston, 4, with the piston bar, 5. The latter is threaded at the lower end. As a tightening means between the case and the piston there is a seal of endurable synthetic rubber. In the spring case, 2, is a powerful steel spring, 6. The piston is guided by an externally threaded sleeve, 7. The thruster is fitted with a lubricator, 8, to oil the piston rod.

When compressed air is released into the inlet, 9, the piston is pressed downward to the limit of the stroke. On releasing the air pressure the piston is rapidly returned to its original position by the spring, 6.

Stroke varies between 2·165 and 2·362 in.

Circle **45** *for further details.*

Medium Power High Linearity Output Transistor

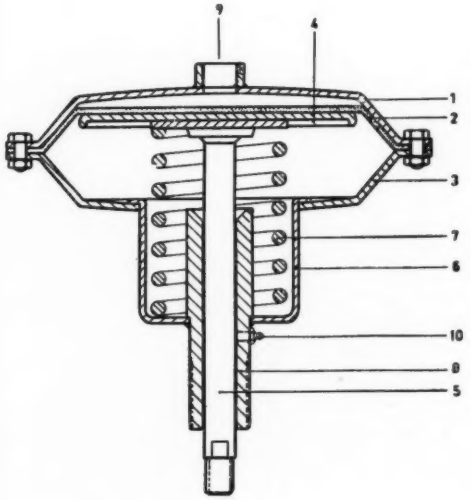
INTENDED as a lower cost alternative to the recently-introduced OC84, the Mullard OC83 is a medium-power output transistor of the germanium p-n-p alloy type, for industrial a.f. amplifier and switching applications.

The device has a peak current of 1 A and a high linearity of current gain—the minimum gain at 50 mA is 50, and even at 300 mA it is still 40.

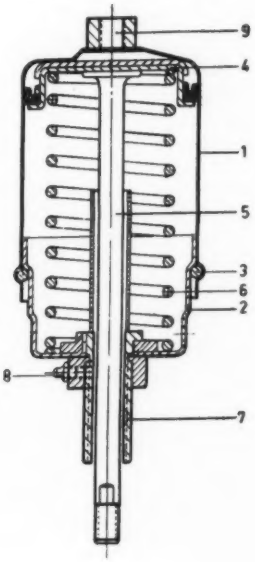
These two factors enable the OC83 to be incorporated into designs for inexpensive low distortion audio amplifiers. Furthermore, when the transistor is used in conjunction with relays and other electro-mechanical devices, its high gain substantially reduces the input signal needed to drive it.

The absolute maximum voltage ratings for the OC83 include a collector to base voltage of −32 V, and a collector to emitter voltage of −32 V. In addition the transistor is designed to withstand a collector to emitter voltage of −20 V for all currents up to 300 mA.

The OC83 has the high junction temperature rating of 85°C which, coupled with the low thermal resistance of 0·25 mW/°C in free air, makes possible a dissipation of 160 mW in an ambient temperature of 45°C. With the device mounted on a suitable heat sink, this dissipation can be increased to 400 mW in the same ambient temperature. The collector leakage current is also



◀ *Wilcox diaphragm thruster*



Wilcox cylindrical thruster ▶

very low, being 10 microamps maximum at a collector-base voltage of −10 V, and at a junction temperature of 25°C. The typical cut-off frequency (f_1) of the device is 850 kc/s.

In spite of its high peak current and high dissipation ratings, the physical size of the transistor has been kept small and it is encapsulated in a metal can, the dimensions of which are 15·7 mm × 5·75 mm.

Both the OC83 and the OC84 are now in production and both types are supplied singly or in matched pairs.

Circle **46** *for further details.*

Liquid Level Controller

THOMAS INDUSTRIAL AUTOMATION LIMITED has now produced a compact conductivity operated liquid level controller known as the "Resistron".

The "Resistron" is intended for use with any conducting liquid providing the specific resistance does not exceed 50,000 Ω/cm³. It is ideal for the control of various types of acid and controlling the level of water in feed tanks, etc. In conjunction with a high temperature electrode it can be used for boiler level control, and will give audible and visual alarm as well as taking corrective action when the water in an unattended boiler has fallen to a dangerous level.

The following is a brief specification.

Sensitivity:

High and low level controllers Type RS500A and B have fixed sensitivity. For liquids up to 50,000 Ω/cm³ specific resistance.

High or low level controllers Type RS500/C have continuously variable sensitivity control and high/low level change-over switch. For liquids up to 50,000 Ω/cm³ specific resistance.

Stability:

Stability is ensured by the use of high-grade mains transformer and components as well as a dust-sealed relay and special purpose valve.

Relay Contact Rating:

One normally open, one normally closed contact, rated at 5 amp at 250 volts a.c.

Mains Supplies:

Standard version covers supplies of 110 volts, 240 volts, 440 volts. 40-60 cycles. Other voltages to requirements.

Case Dimensions:

Width, 4⅞ in. Height, 6⅞ in. Depth, 4½ in. Standard instruments in sheet steel cases—heavy cast iron case supplied—suffix type number H.

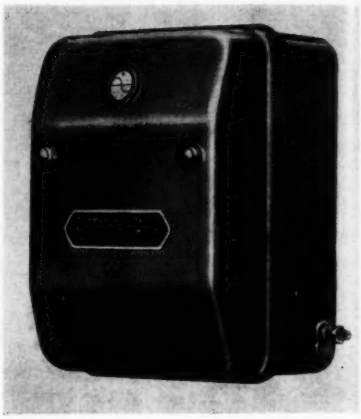
Indicator Lights:

One red, one green, fitted to case lid.

The controller is available in a substantial sheet steel or cast iron case fitted with two signal lights. The "Fail to Safe" facility is standard on all types.

Two electrodes can be used with one controller to give high and low level alarm or control facilities. A special range of electrodes is available for all types of industrial application—Prices range from 14 gns. on a 4-week delivery.

Circle **47** *for further details.*



"Resistron" liquid level controller

Miniature Tubes

RCA announces six miniature tubes: 3DT6-A, 4DT6-A, 6DT6-A, 5GH8, 6AU6-A, and 6AN8-A.

3DT6-A, 4DT6-A, 6DT6-A *Sharp Cut-off Pentodes*

The 3DT6-A, 4DT6-A, and 6DT6-A are sharp cut-off pentodes intended especially for use as f.m. sound detector tubes in TV receivers. Designed so that grid No. 1 and grid No. 3 can each be used as independent control electrodes, these tubes may also be used in delay circuits, gain-controlled amplifier circuits, and mixer circuits.

The 6DT6-A is like the 6DT6 but has a grid-No. 1-to-plate transconductance of 1,350 micromhos approximately 60% greater than that of the 6DT6. As an f.m. sound detector tube, the 6DT6-A can supply approximately 2 dB greater a.f. output than the 6DT6.

In a typical locked-oscillator quadrature-grid f.m. detector circuit, a 3-, 4-, or 6DT6-A can perform the combined functions of a detector and limiter tube and is capable of providing a sensitivity of 18 millivolts r.m.s. with ±25 kc/s deviation. Furthermore, with a 200-millivolt r.m.s. signal to the driver tube grid, these tubes can provide a.m. rejection in the order of 25 dB with ±25 kc/s deviation, and can supply an audio output voltage of 20 volts r.m.s. at about 3% total harmonic distortion.

Except for heater ratings of 3·15 volts/0·6 ampere and 4·2 volts/0·45 ampere respectively, and controlled heater warm-up time, the 3DT6-A and 4DT6-A are identical to the 6DT6-A.

5GH8 *Medium-Mu Triode, Sharp Cut-off Pentode*

The 5GH8 is a medium-mu triode, sharp cut-off pentode, of the 9-pin miniature type intended primarily for use in multivibrator-type horizontal-deflection circuits in TV receivers. It is also suitable for use as an a.g.c. amplifier or sync-separator tube in such receivers. Except for its 4·7 volt/0·6 ampere heater having controlled warm-up time, the 5GH8 is like the 6GH8.

6AU6-A *Sharp Cut-off Pentode*

The 6AU6-A is a sharp cut-off pentode of the 7-pin miniature type suitable for use in a wide variety of applications in TV, f.m., and audio amplifier applications. Because of its high transconductance and controlled heater warm-up time, the 6AU6-A is particularly useful as a limiter tube in f.m. receivers employing

series-heater string arrangement. Except for controlled heater warm-up characteristic, the 6AU6-A is identical with the 6AU6.

6AN8-A *Medium-Mu Triode, Sharp Cut-off Pentode*

The 6AN8-A is a medium-mu triode, sharp cut-off pentode of the 9-pin miniature type for use in wide variety of applications in TV receivers. The pentode unit may be used as an i.f. amplifier or a reactance tube. The triode unit is useful in low-frequency oscillator, sync-clipper, sync-separator, or phase-splitter circuits. Except for controlled heater warm-up characteristic, the 6AN8-A is identical to the 6AN8.

Circle **48** *for further details.*

Safebloc Mains Coupler

THIS coupler, manufactured by Rendar Instruments Ltd. provides a means of connecting 2-core or 3-core bare-ended flexible leads to a.c. mains.

The base and lid of the block are moulded in thermo-setting plastic insulating material, and when the lid is closed all live items are completely inaccessible. The live line is fused with a 5 A fuse as standard, but any fuse up to 13 A can be inserted to suit the apparatus being tested.

The terminals are nickel-plated, corrosion-resisting clips colour-coded green, red and black and marked L, N and E to give instant identification. Closing the lid completes the connection to the supply.

Provision is made for securing the block in any convenient position on bench or wall.

The size of the block is 5 in. × $2\frac{5}{8}$ in. × 2 in.

Circle **49** *for further details.*

Adjustable Square

THE Moore & Wright adjustable square will indicate not only that there is an error in squareness, but also, by micrometer reading, will show the actual error in squareness at the top of the blade.

The tool must always be used on a surface plate or a similar accurate surface. The blade is pivoted on hardened studs at the front of the base by means of an axial movement of the micrometer screw. When the blade is truly square the micrometer head will read zero.

Circle **50** *for further details.*

Activated Charcoal Filters

ALFRED BULLOWS & SONS LTD., of Long Street, Walsall, are introducing a range of activated charcoal filters. These have been designed for use in compressed air systems where oil in the air stream is not acceptable. They remove all traces of oil from the air and also eliminate the smell generally associated with oil in aerosol form.

Each filter consists of an outer case and lid with a cartridge of activated charcoal and conforms to British Standards where applicable. Provision is made on all filters for four-point wall mounting.

The cartridge of activated charcoal removes oil from the air stream by adsorption and is therefore an expendable item which requires changing at intervals, dependent upon operating conditions. An average normal life of a cartridge element is 1,000 to 1,500 working hours.

Quick and easy cartridge replacement is one of the key design features. Air inlets are located in the bottom and air outlets at the side of the filters, so that when changing the cartridge it is not necessary to break the air connections. The lid, which is sealed with an "O" ring, is removed, cartridge changed and lid replaced.

Circle **51** *for further details.*

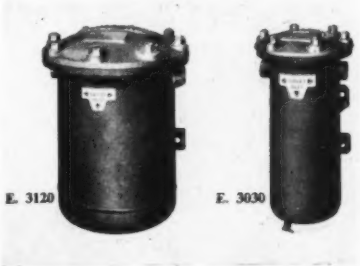
Automatic Liquid Sampler

THE sampler consists in essence of a complete self-contained unit fitted with twelve 20 oz sample bottles. Each bottle is sealed by an airtight plug through which passes a rubber tube connected to an outlet. All the outlets are accessible on a panel at the end of the unit and both bottles and outlets are numbered for easy identification.

The rubber tube from each sample bottle is controlled by a magnetic pinch valve. Each pinch valve can be manually closed and subsequently re-opened electro-magnetically. The magnetic pinch valve is closed manually and retained by a permanent magnet. It is re-opened by a pulse from the power supply via the stepping relay which opposes and overcomes the pull of the permanent magnet.

To prepare the unit for carrying out a sampling sequence it is first necessary to evacuate each sampling bottle by means of an external vacuum pump. This is

◀ *Squaring machine*



Activated charcoal filters ▶

achieved by connecting each outlet in turn to the vacuum pump and opening the relevant magnetic pinch valve by means of its appropriate switch, there being twelve such switches mounted in the unit above their respective sample bottles.

When this preliminary evacuation has been completed the manual switches are closed, in turn, retaining the vacuum in the bottle and the external pump is then disconnected.

The unit contains, in addition to the sample bottles, associated tubing and pinch valves, a fifteen-day clockwork motor and a transistorised power pack, driven by a 6 V lantern battery (giving several weeks' life). The pinch valves are automatically opened at predetermined intervals controlled by the time clock. The time clock actuates a microswitch at each interval and at each operation a condenser is discharged through the coil of the stepping rotary switch advancing selection by one position. This at the same time causes the coil of the pinch valve to receive a pulse, thus releasing the valve of the selected sampling bottle and causing a sample of the liquid under examination to be driven into the bottle by atmospheric pressure. The outlets from each bottle which, as mentioned above, are brought up to an outlet panel, will of course have been immersed in the liquid under investigation by means of a suitable rubber tube which should not exceed 3 to 4 yds in length, via a rustproof filter.

The complete unit measures 24 in. × 15 in. × 10 in. and is provided with a carrying handle at each end. Each of the long sides forms a door which is hinged along the lower edge, thus exposing six sample bottles and the appropriate switches on each side. In addition there is a central control panel on one side only which carries the following controls:

(1) Sample period selector (providing for one sample every one, two or four hours)
(2) The manual winder for the clockwork motor
(3) An on/off switch which initiates the sampling cycle.

The sampler case is constructed of mild steel with an aluminium outer shell, thus keeping weight down to a minimum whilst retaining maximum rigidity and strength to withstand rough handling under arduous outdoor conditions.

The case is rendered water-tight by the use of neoprene rubber sealing gaskets on the doors and is provided with adequate rubber feet.

The equipment is the subject of British Patent Application No. 5581/58, the rights in which are held by the N.R.D.C. from the Water Pollution Research Laboratory, where many units of this type have been used extensively for several years.

The detail design of the timer unit is by Briggs & Davies, of the Water Pollution Research Laboratory, and it is available from Elcontrol Ltd. at a provisional price of £200.

Circle **52** *for further details.*

Solartron—Electronic Reading Automation (ERA)

In the April, 1957, issue of this journal an account was given of the prototype model of the Solartron Electronic Reading Automation (ERA). The production model was recently demonstrated. To save readers the trouble of referring back, the essential features of the equipment are given below.

The upper part of the reading console of ERA showing tally roll feed compartment (left), control panel and roll ejector compartment (right)

1. Primarily, though not essentially, ERA is designed for reading records such as those produced by cash registers. The particular registers associated with ERA are the Regna pattern manufactured by the Jorgen S. Lien Co.
2. Records in the form of rolls may accommodate 3 to 1,800 lines of numerical characters
3. Lengths of roll may vary between 20 in. and 48 ft
4. Each character is scanned by a flying spot pattern scanner similar to that used in telecine equipments. An electrical pattern is generated varying with the character scanned. The pattern is analysed by a special logic unit, virtually a form of digital computer
5. A typical machine reads 0-9, 10, 11 and ½ together with seven alphabetic characters and one special symbol (+ for example)
6. Scanning, recognising and generation of appropriate signal takes about 1/300 part of a second. The overall operating speed is then about 290 characters á second. Practically, however, speed is dependent to a certain extent on roll length, loading and unloading. But the figure may be taken as 200 characters per second with safety
7. The roll will stop automatically if the machine cannot decipher a character. The operator may then note the character or supply manually the necessary information
8. The output from ERA may be processed by a computer to produce the necessary printed tabulations of totals and sub-totals. The output may equally well operate a card punch, a tape punch, a sorter or be recorded on magnetic tape
9. The reader has an error rate of better than 1,000,000 characters for a specified quality of print.

Circle **53** *for further details.*

Level Indicator and Controller

The "Levelrator" of Thomas Industrial Automation Ltd. not only gives continuous indication of the contents of silos, tanks, hoppers, etc., but will also operate

visual and/or audible alarms. The equipment uses one electrode only. Alarm points can be set to operate over the full length of the electrode to suit the particular application.

The electrode system can be of the rigid variety for a small vessel and the flexible type when the depth of the container exceeds 6 ft. The limitation of length of electrode is dependent upon the particular application, but electrodes are available up to 60 ft in length.

The high or low level control points are completely independent of the indicating instrument, and the relays are operated by a specially designed electronic circuit. The long term stability and reliability of this equipment is high, and it is virtually unaffected by normal mains and temperature fluctuations.

The control unit consisting of a stabilised power supply, alarm relay circuits and built-in calibrating instruments is housed in a specially designed cast-iron or sheet steel weatherproof case in first-grade industrial finish, and can be situated up to 150 ft from electrode head unit. The built-in calibrating instrument has a scale length of $2\frac{1}{2}$ in. and this is graded in 2% divisions and can, if necessary, be used as a local indicator.

Remote indicators can be supplied to customers' requirements, and sited anywhere on the plant. The "Levelrator" can be supplied in multipoint units which allow centralisation of all the control and indicating meters. Meters can also be supplied for fixing to existing panels and control desks.

By the use of the specially designed electrode systems, and by careful positioning of these electrodes in the containers, high accuracy nearly linear scales can be achieved.

The equipment can be supplied for all standard mains voltages. The price for a "Levelrator" fitted with both high and low level alarms is approximately £100. Delivery is at the moment 10 weeks.

Circle **54** *for further details.*

ULTRASONIC CLEANING PLANT

CERTAIN authorities and manufacturers, particularly in the nuclear plant field, are demanding a very high standard of cleanliness in equipment supplied, so much so that the requirements can only be met by special solvents and ultrasonic cleaning systems.

In view of this, Cockburns Ltd. have installed a clean conditioning room at their Cardonald factory for treating control valves and control equipment generally.

This room is an air-tight structure of insulated steel panels with an air lock door. Clean, dust-free air filtered to 5 microns is supplied to the room by an air-conditioning plant which maintains an internal pressure of 2 in. w. g. above atmosphere so that dust cannot enter.

Because of Glasgow's atmospheric conditions, a special fog filter has been installed.

Operating personnel wear special nylon clothing and a changing room with showers is provided for them.

The cleaning plant consists of a specially designed 2 ft cube autoclave with revolving carrier, solvent sprays and transducers in the base for the introduction of ultrasonic waves. The autoclave is placed within the clean conditioning room and connected to a closed-circuit solvent supply and drying system. The system, which is controlled by pneumatic valves, embodies storage tanks for preheating and conditioning the perchlorethylene solvent, a filter battery pump and ring vacuum pump. For recovery of solvent, a distillation plant has been installed, comprising a still, and a condensing unit. It is situated outside the clean room.

The sequence of operation is pre-rinsing, solvent cleaning with ultrasonic waves, vacuum applied to remove air from all cavities in the components and vacuum drying, all carried out in the same autoclave at a predetermined temperature. Pre-conditioned solvent is fed into the autoclave through sprays, while the carrier rotates, exposing all surfaces of the component to the solvent spray.

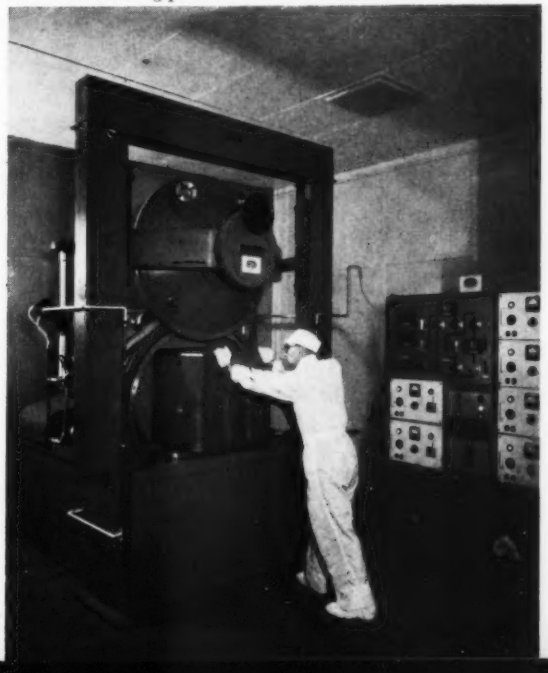
Solvent is recirculated through the filter battery, ensuring complete removal of all solids.

The autoclave is then refilled with filtered solvent. A vacuum of 70 cm Hg is applied and held while the generators are switched on, introducing ultrasonic waves through the transducers. The carrier rotates during this operation to ensure complete cleansing.

After ultrasonic treatment, the load receives a final rinse, solvent is drawn off, and vacuum is applied to the autoclave for drying. A cooling coil situated in a sump at the back of the unit condenses the vapour into the coil chamber, leaving the work perfectly dry, and cleaned down to 1·5 micron filter. The load is then removed, and components are assembled and sealed in polythene containers, and stored in the clean conditioning room until required for dispatch.

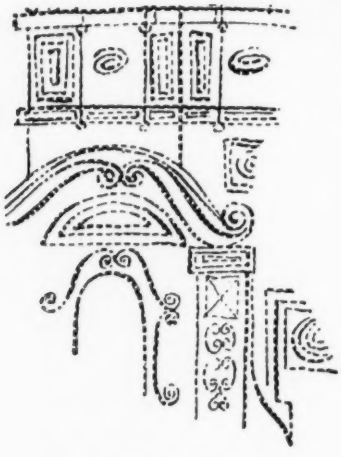
Cockburns Ltd. offer this cleaning service to all interested concerns.

Valves and fittings for a nuclear installation being loaded into the autoclave in the new £20,000 ultrasonic and vacuum cleaning plant at Cockburns Ltd.



Circle 172 for further information

Straight from Prague
—the Home of Polarography



Also available are the manual polarograph and the photographic recording polarograph

KOVO
polaroscope

for simplicity, speed, reliability

Designed by Professor Jaroslav Heyrovsky, the Nobel Prize Inventor of the Polarograph, the Kovo comes direct from the manufacturers in Prague—the home of Polarography.

A 50 c.p.s. A.C. is superimposed on a polarographic electrode system. During each cycle the polarizable electrode is charged from 0 to -2V, and then back again from -2V to 0. The oscilloscope shows dV/dt (vertical) against V (Horizontal). The oscillogram for a pure carrier electrolyte has an oval shape, its upper half is the cathodic branch, the lower the anodic. When a depolariser is present the curve indicates incisions as shown above. Their depth is proportional to concentration. If displaced horizontally it indicates that the electrode reaction is not reversible. The instrument is suitable for analysis in the range 10^{-3} to 5×10^{-5} M. By use of electrolyte concentration (Switch 'MICRO' on the instrument) or by a hanging drop method, 10^{-9} can be reached. A mechanical drop time controller varies the drop time between 1 and 7 seconds. Comparative titrations can be performed by using twin electrode systems, and observing two oscillograms displaced horizontally. Titrant is added until the depth of incisions coincides. Isomers and compounds of similar structure can be very easily examined and identified.

UK Agents For KOVO

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PREVIEW

The Institute of Physics and The Physical Society

16th to 20th January

1961 Annual Exhibition

Admiralty Research Establishment
Stand No. 135

The **Admiralty Engineering Laboratory** is exhibiting the vortex tube, which has been used successfully to supply cool air to a suit designed to protect the wearer in hot environments. With an air supply of 75 p.s.i., 70% air utilisation is achieved when dropping the temperature from 180 to 80°F. The principle of operation is that the flow tends to a forced vortex in which there is an energy variation across the diameter; thus air in the core is cool relative to that on the outside.

The **Admiralty Oil Laboratory** is showing a miniature fluid velocity indicator; for the class of non-Newtonian fluids which exhibit thixotropic behaviour, it is required to distinguish between the "normal" laminar flow of a Newtonian fluid and "plug flow" which is often ascribed to thixotropic fluids. A method for obtaining the velocity profile of any fluid has been developed.

The **Admiralty Materials Laboratory** is to be represented by a portable dissolved oxygen meter, which has been developed for the measurement of the dissolved oxygen concentration in a 250 ml sample of boiler feed water, both in the presence of normal impurities and in water saturated with hydrogen.

The **Admiralty Surface Weapons Establishment** is showing a high-speed symbol writing equipment which illustrates a method of high-speed electronic writing on a cathode-ray tube; semiconductor switches and ferrite cores are used to produce the required waveforms. The symbols are made up of eight to ten straight lines, and are written at a rate of 10 μs per figure. Fully-transistorised circuits using pulse techniques are employed and digital inputs from a computer can be accepted. In addition, a new development in servo amplifiers is being displayed. This is an amplifier constructed of transistorised modules or standardised sub-units so that a standard amplifier can be used with all classes of servo systems. The modules can be selected to give the required stabilising characteristics. A split-field motor-driven servo system is to be demonstrated.

The **Services Electronics Research Laboratory** is showing a compact pulsed generator of fast neutrons; a new form of fast neutron source consists of a sealed-off discharged tube in which deuterium ions are accelerated at up to 100,000 V on to a tritium loaded target to produce 14 MeV neutrons. The tube operates at uniform deuterium pressure achieved by a titanium deuteride replenisher and Pirani pressure gauge. The source is capable of giving 10^8 neutrons in a 20 μs pulse at one pulse per second. It may also run continuously at a level of 10^7 neutrons per second. Other exhibits being displayed include an S-band cyclotron wave amplifier, and a 5 kW c.w. X-band travelling wave amplifier.

The **Admiralty Experiment Works** is to exhibit a frigate model for investigation of ship motion in waves. This is to be a 16 ft model to be used for measuring the response of the hull when running on a number of different courses. The model is equipped with an automatic course control and also an overriding radio control as well as means for recording ship motion and waves. An aircraft-type horizon gyro is used for measuring roll and pitch, and an accelerometer mounted on the gyro is used to sense vertical motion.

H.M. Underwater Detection Establishment is showing a number of electronic instruments which have been developed for research and for test and repair of asdic equipment ashore and afloat. These form part of a rationalised list of Naval test gear.

Associated Electrical Industries Ltd.
Stand No. 131

The **A.E.I. Aldermaston Research Laboratory** is to display automatic data-processing equipment used in thermonuclear research, and also various alignment devices.

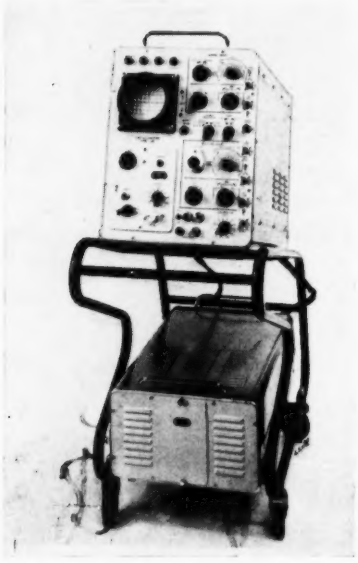
Among the exhibits of **A.E.I. (Rugby) Ltd.** are to be examples of developments in semiconductors; some new glass systems are also to be shown.

Developments in industrial valves, cathode-ray tubes, ceramic valves and photo multipliers will represent **A.E.I. (Woolwich) Ltd.**; this company will also display leak-detection equipment, a Penning vacuum gauge and control unit, transistor stabilised power-supply units, a transistor circuit analogue, a new principle in quadrature modulation systems for single sideband generation.

The **A.E.I. Lamp and Lighting Company** are to exhibit light sources of daylight quality for colour matching purposes, and high-efficiency sodium lamps.

Items of research to be displayed by **A.E.I. (Manchester) Ltd.** include an inductive coupled 50-cycle bridge for low-dielectric loss measurement, a magnetic tester of interlayer airgaps between steel plates; other features are to be the cathodic etching of metals, the pneumatic gauging of internal bores of tubes, the measurement of the variation of internal dimensions of components, and the measurement of rubbing properties of materials at high speeds. Scientific apparatus to be shown by A.E.I. (Manchester) Ltd. includes the LD-2 mass spectrometer leak detector, the MS-10 production model mass spectrometer, the RS-2 complete production equipment, and the Type 12 vacuum coating unit.

A do-it-yourself pump kit will also be on view.



High speed oscilloscope, Type 294 (*Airmec*)

Advance Components Ltd. **Stand No. 86**

The following new products are to be exhibited by this company: 10 Mc/s transistorised measuring counter, Type TC.2; transistor tester, Type TT.1; "Q" meter, Type CM.1; sound spectrometer, Type SPM.1; power supplies, Types PP.2 and PP.4; and v.h.f. attenuators, Types A.100 and A.101.

The sound spectrometer SPM.1 is a self-contained lightweight instrument which has its own battery power supply. It is of modern design, and may be applied to sound measurement problems and analysis. It can also be used with a suitable vibration pickup for vibration analysis in the audio frequency range. This spectrometer consists of a small crystal microphone; a six-stage amplifier, stabilised by heavy negative feedback; eight bandpass filters, and a moving-coil meter with a dB scale. An attenuator is built in with five steps of 10 dB, covering a range of 30-80 dB, with an additional attenuator of three steps of 20 dB covering a range of 0-60 dB. Including the meter the total range of the apparatus is from 20-150 dB.

The transistorised stabilised d.c. supply, Type PP.2, is a heavy duty power supply designed for use in the development of transistorised equipment; it provides a stabilised d.c. voltage over the range 0-50 V at currents up to a maximum of 10 A. The output voltage and current are monitored and the instrument is protected against overload conditions by an electronic circuit similar to that used on Advance models PP.3 and PP.5.

Airmec Ltd. **Stand No. 46**

This stand is to contain examples of recent Airmec developments, including the company's high-speed oscilloscope, Type 294. This is reputed to be a versatile laboratory instrument. Its wide range of sweep speeds, wide frequency response, and the short rise time of the Y amplifier combine to make it a useful instrument for high speed pulse applications. Further features of the Type 294 include accurate calibration of the time bases and deflection amplifier, the provision of time and voltage markers, and comprehensive sweep delaying and triggering facilities. Pulse outputs synchronised to the internal time bases facilitate operation in conjunction with complex electronic equipment. Illuminated beam-position indicators and colour-coded logically-sited controls tend to simplify operation. A single-shot sweep, variable edge-lighting of the graticule and switched alternative to p.d.a. potentials provide for effective photography of the trace.

Two new instruments to be shown for use in the very low-frequency field are the signal generator, Type 257, and the phase meter, Type 281.

Baird & Tatlock (London) Ltd. **Stand No. 136**

The ANALMATIC auto-titrator, capable of a wide variety of applications employing methods involving pre-set pH, "dead-stop" and other potentiometric end-points and colorimetric end-points will be shown.

The auto-titrator to be demonstrated is equipped with a wide range of facilities for simulating and testing a variety of applications. Each auto-titrator manufactured as a result of successful trials with this "universal" instrument includes only those particular features required for the specified duty.

The ANALMATIC process monitoring polarograph, employing a Cambridge a.c. polarograph, performs automatic repetitive sampling, analytical pre-treatment, and polarographic analysis of liquid from one or more sources, and records the results.

The instrument to be demonstrated is a comprehensive equipment for application feasibility trials.

A portable dissolved oxygen meter will be shown. This is designed for measurements on samples in bottles, and incorporates a calibrated meter in place of the recorder.

The automatic curve-plotting titrator can be used for any potentiometric titration, and records the "titration curve" relating the electrode p.d. or pH to volume of titrant.

In the multi-detector gas chromatograph for fuel gases carrier gas from a pressure cylinder is passed into the instrument and the pressures and flow rates are indicated. A sampling device is incorporated which measures out accurately an aliquot of the gas mixture. There is a choice of five sample sizes which are set by panel controls. Four separate interchangeable columns each of length up to 2 metres are connected in series into a thermally-stable detector block. A thermistor detector is mounted at the outlet of each column. The output of one of these detectors is selected by a switch, then compared with a reference thermistor and the resultant chromatogram recorded on a standard pen recorder. The cabinet housing the columns, detector block and sampling unit is thermostatically controlled at 30°C.

The repeated reading of a meniscus formed by liquid in a burette can be extremely laborious. The results are prone to errors due to parallax and to optical differences between operators.

The mercury piston device to be shown offers a semi-automatic, motorised or manual arrangement for obtaining a direct digital read-out of meniscus displacement.

C. Baker Instruments Ltd. **Stand No. 92**

C. Baker Instruments Ltd. will be exhibiting the following:

The "Metalette" inverted metallurgical microscope which has extremely wide ball bearing focusing slides, lever and scroll focusing actuated by vertical concentric focusing knobs, and high impact polystyrene "wrap round" case. It has unusual rigidity and is designed to use the Wayne Kerr "electronic micrometer".

The McCarthy phase contrast apparatus for immunology and virus work.

Other exhibits will include a flat field microscope objective ×40, a ×20 stereoscopic magnifier, and the Patholette microscope.

Baldwin Industrial Controls Ltd. **Stand No. 127**

The Colormat, an instrument for measuring and comparing the colour of surfaces or powders when illuminated by visible or ultra-violet light, is to be featured among items of photometric equipment on this stand. Other instruments to be demonstrated include a line densitometer, designed for the measurement of the transmission density of black and white, and colour 35 mm films, and a glossmeter used in conjunction with a Baldwin photometer for the measurement of gloss over a wide range of surfaces. Further demonstrations will feature the nephelometer, also used as an attachment to a Baldwin photometer, for the measurement of the turbidity of fluids; a colour negative

Transportable beta gauge (*Baldwin Instrument*)

evaluator, designed to assess the amount of filter correction required to print colour negative material, and a flame photometer which gives fast, accurate determinations of calcium in blood sera with an accuracy of $\pm 1\%$ of the observed value.

Nucleonic gauges to be shown include the differential gauge with memory device, incorporating the Baldwin magnetic analogue memory device; the automatic standardising gauge, which is a development of a standard beta gauge, which initiates the withdrawal of the measuring head from the material at predetermined intervals, and the transportable beta gauge, a simplified general purpose beta gauge specially designed for applications where the refinements of a standard gauge are not required.

General instruments to be exhibited are a moisture meter, which operates on the principle of dielectric capacity, a capacity discharge wire welder for the production of thermocouples, an automated balance with digital print out, and a nucleonic profiler, which records variations in weight per unit area.

R. & J. Beck Ltd. Stand No. 93

A demonstration will be given of the Optomax microscope with photo-electric meter. An interpolated beam-dividing unit enables both binocular and photomicrographic units to be fitted simultaneously, along with a third tube to accept a photo-electric exposure meter specially calibrated for photomicrography.

The null-point absorptionmeter to be shown has been developed in collaboration with Dr. R. H. Kay, of the University Laboratory of Physiology at Oxford.

The micro-hardness testing microscope has been designed in collaboration with Associated Automation Ltd. to accept the G.K.N. micro-hardness testing apparatus. It can be used for many types of investigation without removing the hardness testing unit.

Other exhibits will include a one metre research cathetometer, a research optical bench and a contact lens spherometer with projection head.

British Iron and Steel Research Association Stand No. 53

The evolute camera unit has been designed to reproduce on a single flat plate an image of the complete surface of a cylindrical specimen. It has been used to make permanent records of the condition of short lengths of cast iron and steel pipes after they have been subjected to soil corrosion.

Tinplate and cold rolled strip need to be inspected during manufacture for surface defects or blemishes. At high line speed this can no longer be done by the unaided eye. The factors involved in rendering the fault visible may not be explicitly appreciated and exhibits will demonstrate techniques employed at B.I.S.R.A. in developing instrumental aids to visual inspection, as well as for studying the feasibility of fully automatic high-speed inspection.

It is generally accepted that low-energy exo-electron emission in the case of metals is caused by crystal imperfections in freshly formed or distorted oxide layers resulting from plastic deformation. Exo-electron emission has, therefore, been used to study such surface phenomena as oxidation, mechanical abrasion and metal fatigue.

The apparatus to be exhibited has as a detecting element an electron multiplier. This must, however, be contained with the specimen under examination within a high vacuum chamber. For examining the effects of torsional fatigue, therefore, provision is made at one end of the chamber for the transmission of a torsional drive to the specimen from outside the chamber. The electrical connections of the multiplier are taken through glass metal seals at the opposite end of the chamber and through a cathode follower to standard counting equipment.

Certain modifications to the apparatus are allowed for in the present design, which will make possible the study of such aspects of exo-electrons as the effects of irradiation with light of a given wavelength, and the heating of the specimen by means of an electric element for obtaining "glow curves".

The continuous measurement of the reduction in gauge in the temper rolling of strip is still a relatively unsolved problem. One approach is to compare the speeds of the strip before and after rolling; the increase in speed is, of course, directly proportional to the percentage reduction in gauge. Magnetic methods of measuring strip speeds have been tried but were found too sensitive to up-and-down movement of the strip in the neighbourhood of the measuring instruments.

B.I.S.R.A. is developing a new method in which two photocells are set on two illuminated spots on the strip surface, the two spots being a fixed distance apart and lying along the passline. Small irregularities in the light reflected from the strip surface give rise to a pattern in the output of the first photocell. After an interval of time, depending on the distance apart of the two photocells and the strip speed, another similar pattern appears in the second photocell. Thus, if the output of the first photocell is delayed (e.g., on a tape recorder) and then added to the second photocell signal, a maximum combined output will be obtained when the delay time introduced is equal to the time for passage of a point on the strip surface between the two photocells. From this delay time, and the known distance between the illuminated spots, the strip speed can be readily calculated.

C.N.S. Instruments Ltd. Stand No. 59

The read-out extensometer is based on a design developed by the National Engineering Laboratory. The instrument consists of a metal cored differential transformer so connected as to form two arms of a mutual inductance bridge. The bridge balance is upset by movement of the metal core and can be restored by adjusting a decade resistance in the opposite arms of the bridge. Thus the design makes use of a null balance principle and is substantially independent of mains variations, amplifier gain, etc.

With the saturable reactor type temperature controller, a stepless control is applied to furnace temperature by the changing resistance of a platinum resistance thermometer which operates the saturating current in a saturable reactor. Also incorporated is a voltage sensing device which varies the furnace current in relation to voltage changes in the mains supply before the effect is reflected by an actual change in the furnace temperature.

The latest modification of the eddy current tube tester with chart recorder will be shown. Based on a design of Aluminium Laboratories, the tube tester was originally developed for the testing of small diameter aluminium tube. Subsequent development has been the extension of the frequency range to include all non-ferrous tubing and non-magnetic (e.g. austenitic) steels.

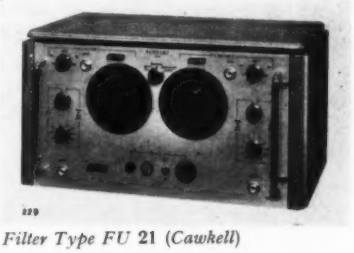
Cambridge Instrument Co. Ltd. Stand No. 54

A microscan X-ray analyser will be seen on this stand which combines the basic technique of microanalysis with scanning facilities; this instrument can display, side by side, an X-ray image showing the distribution of a particular element over the area scanned, and an electron image formed by reflected electrons from the same area. A multi-point boiler feed-water analyser will be shown which records continuously on one chart the results of up to twelve different analyses made on boiler feed-water. A carbon monoxide detector will be shown which it is claimed will be particularly suitable for continuous carbon monoxide determination in road tunnels, workshops, and factories. A prototype extrusion speed transmitter is to be exhibited, and also a pressure transducer, suitable for gauge and differential pressure measurements. A prototype dye-dilution curve recorder Mark II, used for detecting and diagnosing defects of the heart will be on view, and also on this stand there will be a hot roll thermocouple, a proportional counter for Microscan, and a paramagnetic oxygen detector. A Huxley ultra-microtome, now in production, will be shown, and other items to be seen will include a pocket pH meter, a portable potentiometer, and a portable 4-element temperature-controlled standard cell oven. Experimental items featured will be an a.c. comparator, a microvolt detector, and a pencil-type oscillograph galvanometer.

Cawkell Research & Electronics Ltd. Stand No. 103

Cawkell Research & Electronics Ltd. will be showing a number of new devices which will make use of display-storage cathode-ray tubes. These devices include the Remscope, of which a new version will be shown the Tele-Remscope, which is an entirely new design and the Double-Beam Remscope.

A new variable filter is on show in



Filter Type FU 21 (*Cawkell*)

prototype form and will shortly be in production, and the first model of an equipment to measure Young's modulus and damping capacity at extreme temperatures will be demonstrated.

The Tele-Remscope is a picture monitor for use with closed-circuit television systems. Its main feature is that the picture may be "frozen", at any time, simply by depressing a button or by operating a switch.

The Remscope, Type SO1A is a new version of the Remscope which was first shown at this exhibition last year.

It is a fast storage oscilloscope which will store signals at writing speeds up to 4 cm/μ sec, retain them for a week if necessary and display them for up to two hours. Other features include a long persistence facility with a persistence variable from 1 second to 2 minutes, crystal-controlled time calibration and a very wide range of time-base speeds.

The Y amplifier on the Remscope is a plug-in unit which can easily be removed. A new type of Y amplifier will be shown which incorporates a beam switch to give a double-beam presentation.

The Young's modulus equipment has been developed in collaboration with I.C.I. Ltd. and Vacuum Research (Cambridge) Ltd.

The equipment measures the resonant frequency and damping capacity of an accurately made specimen, in a vacuum, at elevated temperatures to a very high degree of precision. A modified version working at low temperatures but not in a vacuum can also be supplied.

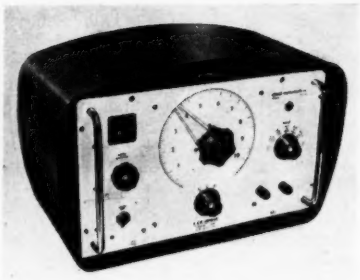
From the data given by this apparatus can be derived the Young's modulus of the specimen and valuable metallurgical results may be obtained.

Cooke, Troughton & Simms Ltd. Stand No. 95

The design of the M606602 stereoscopic microscope to be seen on this stand differs from that of the conventional form of stereoscopic microscope. One objective only is used, and an optical system in the body of the microscope passes left- and right-handed images to the eyepiece to produce the sensation of depth. The point counting stage to be shown has been redesigned and is now stated to be easier to operate. A new design of flat field objective, the 40×, will be shown, in its present form, for use with a cover glass; primary magnification is 40× at 160 mm tubelength, and the working clearance is 0·01 in. Other microscopes to be exhibited will include the M2505FA2, with inclined binocular body, square mechanical stage, and focusing controls at substage level, and the M150012TN2, with inclined binocular body, plain stage, and also with focusing controls below substage level. In addition the M120002EQ2 metallurgical microscope will be seen which has an inclined binocular body, mechanical stage, built-in illuminator, and concentric coarse and fine focusing movements at substage level. The M130001PQ, a high-class microscope, claimed to be of quite new design, will also be displayed.

Cossor Instruments Ltd. Stand No. 121

Three plug-in units for the wide-band amplifier, Model 1076, will be shown. They are: amplifier, Model 1080, with frequency



LCR bridge Model 1446 (*Cossor Instruments*)

range d.c. to 1 Mc/s, sensitivity of 1 mV/cm and provision for single and differential input; amplifier, Model 1081, with frequency range 3 c/s to 40 Mc/s, sensitivity of 5 mV/cm and provision for d.c. connection at a sensitivity of 50 mV/cm up to 60 Mc/s; trigger amplifier, Model 1082, with accurately delayed start of timebase from a few microseconds to 1 second.

Portable double beam oscilloscope, Model 1093, has two identical amplifiers and four ranges of timebase delay.

Double beam oscilloscope, Model 1091, has calibrated timebase velocities from 5 sec/cm to 1 μ sec/cm with arrangements for five times expansion. Oscillograph camera, Model 1458, for high-speed transient work will also be shown.

A storage tube monitor unit with an infra-red illumination hood attached will be exhibited.

Wavemeter, Model 1461, is used to check the resonant frequency of tuned circuits, etc., and can be used either as a grid dip oscillator or an absorption wavemeter.

The true r.m.s. millivoltmeter, Model 1453, provides measurement over a range of 10 mV to 10 V at frequencies from 50 c/s to 10 Mc/s.

Other equipment to be shown will include a transistorised power unit, a fast rise time square generator, a sine/square generator and a one-millimicrosecond pulse generator.

Dawe Instruments Ltd. Stand No. 118

The new Type 418 u.l.f. noise generator to be displayed on this stand provides random electrical noise with uniform spectrum level, over the frequency range 0-200 c/s. The Type 442 transistorised audio signal generator to be shown has been specifically developed for inter-Service use, and provides a stable sine-wave output variable up to 3 V into 600 Ω at frequencies between 7·5 c/s and 1,005 kc/s, with an accuracy better than 1%. The Type 444 automatic l.f. sweep oscillator exhibited has been designed for vibration study, and sweeps continuously all or a part of the logarithmically calibrated frequency range of 5 c/s-5 kc/s.

Other equipment to be displayed includes:

1. Type 446 variable phase adaptor, an instrument for use with the Type 442 v.l.f. and Type 445 u.l.f. oscillators.

2. Type 610C transistor output power meter, which measures the output power and source impedance of audio oscillators, amplifiers and networks, using internal wirewound resistors as the load.

3. Type 618 a.c. Milliclamp, a mains- or battery-operated transistorised instrument which enables alternating current to be measured or examined on an oscilloscope without circuit interruption.

4. Type 630 transistor phasemeter, which measures the phase difference between two signal sources at frequencies between 1 c/s and 25 kc/s, expressed directly in degrees on an indicating meter.

5. Type 1001B 50 c/s transistorised quartz clock, which provides a 7 W, 330 V output at 50 c/s, with a frequency accuracy of 0·0001%

6. Type 1141 transistorised Soniclean ultrasonic cleaner, transistorised 25 kc/s instrument.

7. Type 1202D transistor Strobotorch, a fully-transistorised development of the Type 1202 model.

Other items of equipment which will be exhibited on this stand will be the Type 1208 Variphase strobe unit, the Type 1400E transistor sound level meter and 1400E/PU mains power unit, the Type 1408D transistor sound level indicator, the Type 1409 vehicle noise meter, and the Type 1434 vibration limit controller. Type 1436 vibration calibrator, Type 1437 vibration control amplifier, and Type 1465 variable bandwidth filter will also be on view.

Decca Radar Ltd. Stand No. 25

Items of interest to be found on this stand will include the following:

1. Annular rotating joint for X band, a high-power rotating joint of annular construction: two coaxial rings of waveguide are directionally coupled, the input being connected to one ring, and the output to the other.

2. Coaxial components—a range of broadband coaxial components will be shown: these are designed to operate from 1-12 Gc/s.

3. Ferrite-swept X-band oscillator, an X-band klystron which has been modified to incorporate a ferrite rod in the rear cavity.

4. Coaxial line phase shifter, a coaxial line phase shifter for use in the frequency band 2-4 kMc/s, which has an overall length of only 8½ in.

5. Universal klystron power supply, an instrument developed to provide the necessary operating supplies for most low-power klystrons.

6. Low-loss transmission in rectangular waveguide at millimetric wavelengths.

7. Backward - wave oscillator power supply and output regulator, which in its simplest form consists of two standard 19-in. rack-mounting units.

A range of the company's waveguide switches will also be shown.

Department of Scientific and Industrial Research Stand No. 47

Among the **National Engineering Laboratory** exhibits will be a demonstration of the production and applications to measurement and automatic control of precision radial scales.

The use of radial scales in a moiré fringe error correcting system will be demonstrated on a circular dividing table incorporating a worm and worm-wheel drive. The errors in transmission of uniform motion are reduced by a factor of 20.

A bi-directional random input counter which will accept a train of "add" pulses

and a train of "subtract" pulses of frequencies up to about 30 kc/s each differs from previous bi-directional counters in that it can deal correctly with an "add" pulse and a "subtract" pulse which are are co-incident or have any degree of overlap. The circuit does not rely on the setting and maintaining of any critical values, and reasonable drift in component values will not affect it. This instrument was developed by NEL to compare 2 pulse trains for a shaft speed control system.

An extra high-pressure apparatus which has been constructed by NEL will generate pressures in excess of 100,000 atmospheres in conjunction with temperatures of over 2,000°C.

Pressure calibration is performed by observing the electrical resistance changes which accompany certain phase transitions in metals at very high pressures, for example, such changes occur in bismuth at 24,800 atmospheres, and in barium at 77,400 atmospheres.

Propeller meters designed for flow measurement convert fluid velocity into a rotational speed which can be measured easily. A new meter developed by NEL has the propeller mounted in a hydrostatic bearing and only the resulting viscous friction has to be overcome. An electromagnetic pick-up is built into the bearing to record the rotational velocity of the meter. The advantages sought are: (a) longer life, (b) no alteration in calibration, (c) wide velocity range.

Tests are in progress to determine the best blade shape and the principle will be extended to propeller meters for measuring point velocities in large pipes.

Tensile tests are being carried out on specimens inside a chamber filled with fluid subjected to hydrostatic pressures of several tons per square inch. An image of the specimen is projected through toughened plate-glass windows recessed in the inner bore of the container, on to a ground glass plate. The change in diameter of the specimen is recorded by photographing this image with a 16 mm ciné camera which simultaneously records the load.

The load is measured by a load cell inside the high-pressure chamber. The output is recorded on a chart recorder fitted with a cyclic progressive encoder. The coded information is passed through a decoder to provide a digital display of load.

The British Internal Combustion Engine Research Association will be exhibiting two working models showing applications of the BICERA radio telemetering system. This system avoids the use of slip-rings, flexible leads or intermittent contacts where information from moving parts on the variations of physical quantities (i.e., strain, temperature, relative displacement) is required.

Water Pollution Research Laboratory will be demonstrating an easily portable, submersible, optical density meter suitable for sludge detection and for approximate measurement of suspended solids concentration. A 15 ft pole, made up of demountable sections, carries containers for a 6 volt, 1 watt lamp and a barrier-layer cell. The light traverses an adjustable gap (normally set at 8 mm) between Perspex cylinders.

A suspended solids recorder in which suspended solids are measured in two ranges (0-100 p.p.m. and 0-1,000 p.p.m.) will be shown. Light transmitted, and light scattered, by the sample, falls on the barrier-layer photocell at different frequencies. The respective outputs from the photocell are separated electronically and their ratio continuously recorded on a strip-chart. The measurement is unaffected by changes in incident light, sample colour, amplifier, or photocell.

Dependence on particle size is minimised by homogenisation of sample and use of an infra-red sensitive photocell.

The Electrical Research Association Laboratory exhibits will include film strips showing circuit-breaker principles; an omni-directional gust anemometer with a new type of omni-directional suspension which allows a considerable mechanical magnification, so that relatively large movements are available for the transducer strain gauges. The instrument damping is designed to give a response time better than 0·1 seconds

The new E.R.A. discharge detector, Model 3, has a higher sensitivity and a considerably extended range over former models. It also incorporates a number of improved features. A commercially available version of the instrument will be provided for demonstration.

The British Ceramic Research Association will be showing a range of new high temperature ceramics.

A radioactive rotameter will be shown by the **Warren Spring Laboratory.**

A radioactive float is used in either a glass or metal tube, and the position of the float is detected by a number of Geiger tubes mounted in a large metal housing surrounding a portion of the length of the tube.

Automatic thermal expansion apparatus will be demonstrated by **The British Glass Industry Research Association.** The instrument exhibited, although initially designed for the measurement of the thermal expansion of glasses up to the upper annealing point, is eminently suitable for dilatometric measurements of any other materials.

British Welding Research Association will show a carrier gas method of hydrogen determination. In this apparatus, argon is passed over a sample of steel which is heated in a furnace. The hydrogen evolved is swept along in the argon stream to a hydrogen sensitive electric conductivity cell, the output of which is plotted on a conventional chart recorder.

Ingress of air during sample loading is avoided by a special loading lock and a special burette is used for injecting small measured volumes of hydrogen gas for calibration. The estimated precision of the method, using a 5 g steel sample containing 1 ml hydrogen per 100 g steel, is ±0·04 ml/100 g.

The **Radio Research Station** will be demonstrating the measurement of the complex current gain of transistors at u.h.f. The amplitude and phase relationships between the collector and emitter currents are obtained by comparing the voltages at two appropriate points in a coaxial-line system. The output signals from two probes are passed through two receivers with identical responses and displayed on an oscilloscope, the shape of the resulting elliptical trace giving the complex voltage ratio.

A road heating control unit used to control the electric current in a heating grid embedded in the wearing surface of a road will be shown by the **Road Research Laboratory.**

They will also show a recording speed meter. The time taken for a vehicle to travel between two detectors spaced 70·4 in. apart is measured by counting the number of pulses produced by a 2·5 kc/s oscillator during the period. This time, together with a manual classification of the type of vehicle, is automatically punched on to paper tape for subsequent analysis on an electronic computer.

Among the **National Physical Laboratory's** exhibits will be an analogue model of an adaptive control system. A plant and its controller are simulated using standard analogue computer techniques. A criterion of quality of control is chosen and experimental fluctuations are applied to the settings of the controller. These fluctuations are cross-correlated with a measure of control quality and the output of the correlator is used to change the controller settings in a direction which improves control quality. This process continues until the plant is operating at optimum quality.

The NPL photo-electric microscope was developed in the Standards Division of the National Physical Laboratory, primarily to improve the precision of fiducial settings in the comparison of line standards. A single setting has a precision of better than two micro-inches at 98% confidence level and the instrument has a linear measuring range of between 0·0002 in. and 0·0004 in., depending on the operating conditions. A linear magnification as high as 5×10^5 may be obtained.

A demonstration will be given of polarisation and other features of the light from a tungsten filament. Examination of the magnified image shows that inter-reflection within the filament coils increases the brightness of the insides of the coils by some 60%, although it decreases the colour-temperature of the light therefrom by about 50°K because of the selective reflecting properties of tungsten. Further, the degree of polarisation is not everywhere the same since it depends on the angle of emission from the tungsten surface (e.g., 30% polarisation at 60° to the normal). These features are important in the use of coiled-filament lamps as precise standards of light and colour-temperature.

The design of an absolute radiometer is due to E. J. Gillham, of the Light Division of the NPL. It is similar to the older Guild drift radiometer (1937) in that it measures radiant power directly in terms of electrical power; but its time-constant is very much smaller, so that steady readings replace the drift procedure, while the target is a blackened cavity having a computed absorption factor differing negligibly from unity, instead of a flat surface whose absorption factor needs to be measured. For use in a uniform field of radiation, as from a lamp some distance away, a carefully designed aperture defines the acceptance-area.

The recording spectropolarimeter is of somewhat novel design, in that the functions of monochromator and polarimeter are combined, by using two crystalline

quartz prisms both to disperse the radiation and to polarise it. The optical rotation of the specimen is compensated by means of a Faraday cell and is thus measured in terms of current. The wavelength range of the instrument extends from the visible down to approximately 220 μm.

The British Steel Castings Research Association will be showing a radioactive tracer technique for investigating the origin of inclusions in steel castings. Molten steel flows over clay-bonded sand compacts in which the silica grains have been coated with activated ceria. Autoradiography is then employed to study the inclusions in the steel casting and elucidate the mechanism of their formation from interaction between slag, steel, etc., and the sand.

Dobbie McInnes (Electronics) Ltd. Stand No. 105

Trace analysis and graph-plotting equipment will be displayed on this stand. Examples of tape input and keyboard input graph plotters will also be shown. Following developments in magnetic tape input for graph plotting purposes, various units of interest will be shown utilising M.S.S. Recording Co. Ltd. variable flux reading heads. A 5-channel version of the S.E.F.R.A.M. Rapidgraph will be exhibited, and also the S.E.F.R.A.M. Verispot, an example of the range of ultra-sensitive, shockproof Schlumberger-Picard galvanometers, fitted as a bench model light spot unit. The S.E.F.R.A.M. Graphispot is claimed to be a unique recording instrument, in which the recording mechanism follows a light spot from a mirror, attached either to an external instrument or to a built-in galvanometer.

Doran Instrument Co. Ltd. Stand No. 110

A Zener diode stabilised power unit for use with the Unicam SP.500 spectrophotometer will be shown. This unit was developed for the purpose of supplying a stabilised input, both a.c. and d.c.

The precision electrometer potentiometer combines the function of a precision pH measuring instrument reading directly in pH units and mV and a d.c. potentiometer. Readings are accurate to ±0·001 pH and ±0·1 mV when used with a suitable external reflecting galvanometer.

The polarised electrode autotitrator is based on one developed in the laboratories of the University of the Sarre. A simple platinum electrode system is used which requires no special treatment for satisfactory operation.

The general purpose potentiometer has three measuring ranges of 0-1·8, 0-0·18 and 0-0·018 volts, with an accuracy of ±0·02% and with the smallest reading of 10 microvolts corresponding to 1 division on the slidewire scale.

The portable valve millivolt/pH meter is a completely compact measuring unit for pH and mVs with a current drain on the measuring cell of less than 5×10^{-12}A. The ranges provided are 0-14 pH and 0-1,400 mV with accuracies of ±0·05 pH and ±5 mV respectively. Automatic temperature compensation for slope is provided by a thermistor network and when this compensator is not in use the pH scale reads correctly at a temperature of 20°C.

The de-ionised water conductivity test set is transistorised and the upper range can be used for measurements up to 10 megohms in terms of resistance or 0·1 micromhos in terms of conductivity. The circuit includes a 1,000 c/s transistorised oscillator, a bridge network and a transistorised amplifier with bi-directional moving coil indicator. A small battery with a reasonably long life is fitted internally, and the test set can be used immediately after switching on.

The circuit used in the pH controller for plating tanks is combined with a moving coil indicator provided with transistor photocells which operate a moving coil relay which in turn energises an electromagnetic valve. The control point for pH is set by means of an index pointer which can be adjusted to almost any point on the scale and any rise in deflection beyond this point opens the electromagnetic valve and admits a suitable reagent for restoring the plating bath to the pH value indicated by the index pointer. The accuracy of measurement is ±0·1 pH, the range 0-10 or 4-14 pH units, and the instrument is suitable for use with glass or any other electrode system.

Dynatron Radio Ltd. Stand No. 29

Stabilised power unit N104/5 has been designed to provide sources of stabilised e.h.t. for G-M tubes, ionisation chambers and general types of photomultipliers. One, two or three outputs may be obtained by the use of plug-in units N106, covering the appropriate voltage ranges. The N104 is a mains-powered basic unit which can accommodate up to three sub-units N106 to provide up to three independent outputs in the range of 350 volts to 1,700 volts.

The N105 is similar to N104 but obtains its power supplies from an external unit such as the N1009E scaler. Conversion of an N105 to an N104 can be effected quite easily if required.

Timing unit N108 has been designed primarily to operate with the 1009 series of scaling units from which it can obtain its supplies. The main function of the unit is to switch the scaling unit off at either a pre-set time or a pre-set number of counts and to enable the count and time totals to be read from calibrated decade counting tubes.

Test set N107 comprises a combined double pulse generator and measuring oscilloscope. The unit is designed to provide the necessary services for maintenance of the commonly used instruments in the nucleonic field, e.g., pulse amplifiers, discriminators, scalers, ratemeters and pulse height analysers. A master multivibrator controls the pulse recurrence frequency of the pair of pulses.

E.M.I. Electronics Ltd. Stand No. 20

Among the new developments to be shown will be a single hand monitor designed to cater for the smaller establishment where radioactive materials are handled. Transistors have been used to give a high degree of reliability, and both audio and visual alarms are incorporated.

The low activity sample monitor, which incorporates its own lead castle and end-window Geiger counter to form a complete portable counting system will also be shown. This instrument operates from either mains or battery.

Two new plug-in sub-units for the WM.16 oscilloscope will also be shown on this stand. The high gain amplifier, Type 7/5 incorporates all the facilities offered by the wide band amplifier now in use, and permits an increase of gain by a factor of 10. A wide range of E.M.I.'s special valves and tubes will also be shown. These include photomultiplier tubes, which will operate over temperatures from −180 to +150°C. Tubes sensitive to ultra-violet light with negligible sensitivity to visible light will be on show and the display will also include wide-band tunable cavities for low-voltage plug-in klystrons, covering a frequency range of 2·6 to 11·7 kMc/s, new klystrons for operations between 12 kMc/s and 26 kMc/s, high resolution cathode-ray tubes and a CdS experimental photoconductive cell.

Edwards High Vacuum Ltd. Stand No. 116

A new two-stage, gas ballasted mechanical pump, with a displacement of 500 litres per minute and an ultimate vacuum better than 10^{-4} Torr will be shown. The pump is characterised by extremely quiet vibration-free operation. A special feature is the built-in oil non-return valve which ensures that if the pump stops under vacuum, oil will not rise into the evacuated chamber, which will automatically be held at low pressure.

The mechanical booster pump, Series 1R80, with torque converter drive is a pump of the Roots type, has a peak speed of approximately 3,400 ft³/min (approximately 8,300 m³/hr) and a useful pumping performance over a wide range of pressures down to about 10^{-3} Torr. The pump is driven via a fluid drive torque converter.

Mercury vapour diffusion pump, Model 1ME2, has been specially developed for backing either oil or mercury diffusion pumps of larger size so as to increase the overall critical backing pressure of the combination. By including a backing capacity in the line to the mechanical pump, it is possible to continue evacuation of certain apparatus (e.g., electron microscopes) for prolonged periods with the mechanical pump switched off, with complete elimination of associated vibration and electrical field.

The "Speedivac" range of mercury diffusion pumps has been completely redesigned. The pumps are now constructed in stainless steel with a highly polished interior finish.

A complete range of stainless steel vapour traps is available for use with the stainless steel mercury diffusion pumps described above or alternatively with the range of "Speedivac" oil diffusion pumps.

The vapour trap maintenance system exhibited provides a simple means for automatically refilling a vapour trap at pre-determined intervals. A novel type of level switch in the trap ensures maximum economy in the use of coolant.

Among the high vacuum valves exhibited will be wide bore high conductance isolation valves, a magnetic valve with automatic air admittance, and bakeable ultra-high vacuum metal closure valves.

The leak detector exhibited, a "Speedivac" Model LT7, is specially designed to use hydrogen as a searcher gas and, when required, may be "tuned" for use with helium. The instrument utilises a new type of focusing system based on an axially symmetrical magnetic lens instead of an analysing magnet.

A new two-range Penning cold cathode ionisation gauge, Model 5, measures pressures between 10^{-2} Torr and 10^{-5} Torr in two ranges; by the use of a suitable external meter, pressures down to 10^{-6} Torr can be measured.

Special gauge heads, Models 5MF and 5GH, have been developed for use with this instrument and are characterised by their ability to operate on "dirty" systems for prolonged periods without cleaning. Model 5MF, a metal gauge head, is readily demountable for ease of cleaning. Model 5GH, in hard glass, is arranged for direct joining to all glass systems and, where necessary, can be baked to elevated temperatures.

In the Pirani Penning gauge, Model 2A, the advantages and characteristics of the Model 5 Penning gauge are conveniently combined with those of the "Speedivac" B4 Pirani type gauge. The Pirani type gauge can be provided with two gauge heads, thus pressures on both fine and fore vacuum sides of a system may be monitored over a very wide pressure range.

The Model 6E coating unit is being replaced by a new model, the "Speedivac" 6E2. This miniature unit, with its 6 in. diameter work chamber, incorporates most of the refinements found in large-scale apparatus. Attention has been given to ensure maximum access to all components, both for ease of servicing and to provide maximum versatility as an instrument of education, research and development.

The ultra-high vacuum coating unit, Model 12E8, can be used for the production of thin metal films at low pressure; in particular for the experimental production of transistors, magnetic or superconducting films.

The "Speedivac" coating unit, Model 19E1, has been specially designed for the preparation of films of magnetic materials and experimental or production work on transistors or other solid state devices which, because of contamination hazards, must be vacuum processed at pressures lower than those obtainable in conventional industrial coating plant.

Ekco Electronics Ltd. Stand No. 30

In the complete gamma spectrometer facilities are provided, giving better than 4 : 1 peak to valley ratio for Co^{60}, with the new Ekco scintillation counter N676 which is shown connected to Ekco ratemeter N600. The low output impedance of the counter permits cable lengths up to 100 yards to be used.

The latest model of the Ekco N530 automatic scaler N530G is shown in association with round lead castle N662, a G.M. tube and Geiger pre-amplifier N575. The N530G has improved h.v. stability and an input resolution of 5 microseconds.

A new Ekco ancillary power unit provides stabilised supplies of 300 V h.t. and 200 V to 3 kV for scintillation counters and their associated amplifiers.

Two assemblies will be shown with the Ekco universal scintillation counter N664 connected to Ekco automatic scaler N610. The beta counting assembly can be employed in conjunction with a deep freeze unit for counting tritium. The gamma counting assembly utilises Ekco well crystal N597.

The medical directional counting equipment comprises Ekco scintillation counter N618 which is fitted into directional shield N651 and connected to ratemeter N624. The scintillation counter can be cold-sterilised whilst the directional shield is provided with three alternative collimators and lights for accurate repositioning. For hospital or laboratory use, the full equipment can be mounted on the new universal mobile stand N677.

A range of thallium-activated sodium iodide crystals will be shown.

The Ekco vibrating reed electrometer N616 will be shown connected to high resistance unit N659 enabling unknown resistances up to 10^{14} ohms to be measured in addition to very small direct currents and voltages.

The Ekco field ratemeter N645 is a battery-operated transistorised instrument having ranges of 0-10, 0-100, and 0-1,000 c/s. It will be shown with a new range of heads for alpha, liquid and solid beta and gamma monitoring.

Designed to meet the (Preliminary Draft) Factories (Ionising Radiations) Special Regulations, the Ekco portable radiation monitor N596V has three ranges of 0-3, 0-30 and 0-300 millirad/hour together with an integration range up to 30 millirads with a time constant of 15 hours. An alternative chamber (N659) can be fitted easily for very localised dose-rate measurement.

Representative of the latest Ekco developments in the field of transistorised instrumentation for nuclear reactors are a reactor period meter, logarithmic gamma health monitor and a shut-down amplifier (flux).

Three new Ekco instruments will be shown with specific application to industrial processes. A moisture gauge N680 is designed primarily for use on paper-making machines and provides accurate indication of moisture present in paper within the range 2-75% of moisture content. Alternative models are available giving limited ranges such as 2-15% and 60-75%. The instrument can be used as a moisture controller at the dry end of the machine and can also be used in conjunction with an Ekco substance gauge at the wet end. The latter arrangement makes it possible to measure the dry substance weight at a stage in manufacture previously impossible.

The Ekco storage unit N682, principally designed for coating applications, retains a gauge reading for a pre-set time related to the production process means being provided to synchronise the delay with machine speed. This enables a base material reading to be compared with a reading from a second gauge measuring the coated material. With the delay afforded by the storage unit the "coated" and "uncoated" readings for the same area of material can be compared after the drying or curing process. The difference signals are then applied to an automatic control unit operating screw-down motors on the dip roller or doctor blade. Direct readings of the coating weights applied can also be given on a meter or chart recorder.

Continuous and accurate measurement of metals produced in strip form up to 0·5 in. thick is provided by Ekco secondary X-ray gauge N658 in which X-rays are generated as Bremstrahlung from a strontium 90 source. Completely automatic control facilities are provided by the in-built auto control unit N604.

Ekco transistor inverter E208 is a single-phase static inverter for the generation of close tolerance output voltages of 115 V or 200 V 400 c/s at 500 VA from a nominal 28 V d.c. supply. This instrument is housed in a standard ATR case and conforms to ARINC specification. A 1 kVA three-phase inverter comprising two E208s in a special coupling unit is also shown.

Ekco transistor inverter E210 is a fully-transistorised single-phase inverter. Facilities are incorporated for general-purpose applications and the instrument is stabilised against variations of input voltage. It has an output rating of 15 VA continuous running or 35 VA for short periods not exceeding five minutes.

The transient suppressor, Ekco E212, is designed to suppress, by electronic disconnection, large transient surges which appear on d.c. supply lines to electronic equipment and thus protect transistors and other low voltage components against the destructive effects of such surges. Rated for 28 V d.c., the E212 will operate on a continuous output up to 16 A and provide surge suppression in the range −30 V to +100 V with a triggering time less than 5 microseconds. Overload protection and self-test facilities are provided.

Electro Methods Ltd. Stand No. 58

The new Type 213B transistor relay will be exhibited on this stand.

The new miniature cartridge thermostat will also be shown, and other features will include magnetic amplifiers and saturable reactors for both research and industrial purposes. A new educational magnetic amplifier for use by technical colleges and similar institutions will be shown. This unit allows the saturable cores to be connected in a variety of the more common arrangements in general use. The construction of the amplifier will be clearly seen. Also on display will be examples of the latest developments in electro-mechanical integrators and integrating motors together with a new high-speed photoelectric relay.

Electrothermal Engineering Ltd. Stand No. 5

This stand will feature the radiant zone heater, by means of which highly concentrated heating is obtained by focusing the heat sources optically upon the section or object to be heated.

As the heat is transferred by radiation there is no danger of contamination and the heating element, being remote, allows the unit to be placed over evacuated tubes.

This type of heater has so far been applied to vacuum zone refining, to soldering, to sintering of alloys and to sample heating during physical examinations, e.g., microscopic, magnetic and

X-ray diffraction. It may possibly be used as a means of testing the combustibility of polymeric materials and so improve the reproducibility of existing test methods.

Elliott Automation Ltd. Stand No. 125

Black Automatic Controls Ltd. will be exhibiting a self-actuating constant flow valve, a pneumatic sequence controller rotary valve and a range of pressure switches.

Elliott Brothers (London) Ltd. will be showing a programmed automatic circuit checking equipment, designed to facilitate the outline checking of complex cableforms or similar constructions.

An automatic second-line test set for the complete check-out, testing and servicing of an autopilot system will be shown.

A micrometer dial has been designed to provide a quick and easy method of setting an angular displacement, to the nearest minute of arc, on a variety of small electrical components such as synchros and potentiometers, with a high degree of accuracy, in the order of plus or minus 15 seconds of arc. The micrometer principle is used, thus making the reading and setting far easier than is the case in the usual vernier-type dial. The National-Elliott 803 fully transistorised computer will be shown.

Among equipment to be shown by the **Inertial Navigation Division** will be a frequency recorder, a standard cell temperature controller, and a standard frequency receiver unit.

A precision industrial load cell will be shown by the **Industrial Weighing Division.**

The **Microwave and Electronic Instruments Division's** exhibits will include a range of 4 mm and 8 mm analytical instruments and components, an improved and simplified system of automatic frequency control for microwave oscillators, and a ratio-indicating amplifier of high gain and low intrinsic noise.

The Autolarm, which may be used to detect changes in the ohmic value of a resistance thermometer and is suitable for applications in mines where fail to safety conditions must be kept, will be shown by the **Process Control Division.**

The **Quality Control Division** will be showing moisture monitors, a process chromatograph designed for plant analysis of mixtures of most substances which are in the vapour phase below 65°C, and a mass spectrometer leak detector capable of detecting and locating leaks as small as 5×10^{-11} atm cc/sec/div of helium.

The **Radar Division** will be exhibiting a coaxial directional coupler with variable coupling, a variable coaxial attenuator with low insertion loss, printed circuits at microwave frequencies, radar performance monitors, radar beam position indicators, and an electron spin resonance spectrometer.

Among the equipment to be shown by the **Valve Division** will be high power millimetre waveband and rugged local oscillator klystrons, and monitor diodes.

A multi-channel tape recorder incorporating a tape transport system using dual capstans and take-up assemblies will be shown by the **Weapons Division.** Five tape speeds are available, selected by push-button controls, and at 30 in/sec it is possible to handle frequencies up to 75 kc/s. The equipment is fully transistorised, extensive use being made of printed circuits. Both direct recording and f.m. facilities are provided by modular plug-in units, and remote control facilities are provided for all functions. Principal applications of the recorder are in the guided weapon and aircraft fields for recording telemetered data and for the flight test role.

Elliott Nucleonics Ltd. will be exhibiting a comprehensive scaler designed for both industrial and experimental applications.

Scaler and timer employ direct indicating dekatron counters.

A comprehensive e.h.t. supply which provides up to three independent stabilised e.h.t. supplies which are intended primarily for polarising ion chambers or feeding proportional counters, photomultipliers, and similar equipment, in both industrial and experimental applications will be shown.

The gamma-compensated ion chamber e.h.t. supply provides two independent stabilised positive and negative e.h.t. supply pairs, primarily intended for polarising gamma-compensated ion chambers in both industrial and experimental applications. Each of the four supply voltages is independently variable and each pair is equipped with its own monitoring meter and e.h.t. failure alarm. Both positive and negative supplies are obtained from the same blocking oscillator.

Other equipment to be shown by this Division will include a ratemeter and period meter, a micro-microammeter, a deviation meter, a shut-down amplifier, logarithmic d.c. trip amplifier and a water contamination monitor.

James Gordon & Co. Ltd. will be showing the Konitest dust meter in which a sample of dust-laden gas or air is drawn into the Konitest tube, if necessary by means of a special inlet nozzle. On entering the Konitest tube the dust is thrown to the outside wall by means of built-in vanes and the friction between dust and tube causes both to be charged electrically. The charge taken up by the dust particles flows through earthed outlet-ducts. The charge set up in the Konitest tube itself is passed through suitable sensitive metering devices before being earthed, the current being first amplified so that it can be suitably indicated, recorded or integrated.

The value of the current depends on the physical properties of the dust passing through the Konitest tube and, by comparing the readings with a predetermined dust concentration, it is possible to calibrate a measuring instrument accordingly. The current is in direct relation to the quantity of dust passing through the Konitest tube, providing this quantity is within certain predetermined limits.

The Optimat, a solid state optimising controller, which processes input signals relating to flow, temperature, quality and similar criteria, operating on the set points of conventional 3-term controllers to achieve optimum plant performance, will be shown by **Panellit Ltd.**

The thermal drive actuator, designed for the operation of control valves which derives its thrust (500 lb) from a self-contained vapour pressure system, will be shown by **The Swartwout Co. Ltd.** It operates directly from the controller output signal. Energy input is a constant heat-source provided by a 500 watt strip heater immersed in the fluid.

English Electric Valve Co. Ltd. Stand No. 50

A high gain image intensifier will be demonstrated which has an overall gain of about 80,000. A tube of this type will be mounted in demonstration equipment so that it will be possible to see the amplification and resolution obtainable when viewing a very weakly illuminated test chart. A 600 Mc/s parametric amplifier complete with focusing unit, power supply and matching units (all designed as compatible accessories) will also be demonstrated.

Two new prototype storage tubes will be shown. These will be the E701, a direct view storage tube intended for bright radar displays, and the E709, a picture storage tube with electrical input and output. Piece parts and sub-assemblies for a ceramic tetrode, Type 6181, will be shown, together with a finished valve. They will show, among other things, the ceramic seals, and accurately formed grids.

Ericsson Telephones Ltd. Stand No. 115

The Electromechanical Division will show the following:

1. Photocell-controlled street lighting installation: this exhibit will demonstrate the combined application of a photoconductive cell and a special relay to the control of street lighting. During the hours of daylight the relay is kept energised—and the lights switched off—by the current passed by the photocell. When darkness approaches the current through the photocell gradually drops and when it reaches a certain value—consistent with the light-intensity which prevails at the appropriate "switching on" time—the relay is de-energised and the lights switched "on". At dawn the process is reversed and the relay is energised when the light-intensity reaches the appropriate value.

2. Magnetic shaft speed transducer, used to indicate the speed of revolving shafts or other rotating machine elements without any mechanical contact with them.

3. Microsignal chopper, a further development of the Ericsson polarised chopper. By separation of the input and output connections the design enables minute signals to be chopped without interference difficulties.

4. Multiple miniature relay unit, a compact unit enabling the mounting of five Type "GP" or "GPST" miniature relays within the limits of the space occupied by a single relay, Type 3000. When mounted in standard racks the unit may be "mixed" with Type 3000 relays in any order without fouling. The maximum number of connections is 35 per relay-unit, including coil-terminals.

5. Relay—Type 53, Mk. I and Mk. II, mains-operated a.c. relays for general industrial application. Mk. I will accommodate a maximum of four changeover-sets fitted with heavy-duty contacts to

carry a maximum of 6 A, the Mk. II will take extra-heavy duty springsets up to two changeovers with "Elkonite" contacts to switch approximately 12 A.

6. Relay—Type "GPST", a "plug-in" version of the Type "GPST" miniature relay. The principal feature of this scheme is that it is possible to use the standard "wired-in" version as a "plug-in" relay without any alteration of the relay itself.

7. Polarised G.P. relay, a development of the standard "GP" relay with which it is physically interchangeable. It has a polarising magnet which enables it to be used either as a magnetic latching relay or by suitable adjustment as a sensitive directional d.c. relay. The latching type is released by a reverse current pulse of suitable magnitude and when magnetically latched the two changeover relay will withstand the Services DEF.5011 robustness specification.

The Tube Division will show:

1. Digitrons, dynamic display of recently developed tubes, including the GR.2.H, GR.12.G and GR.12.H, alphabet tubes, and a long-life number tube.

2. Trochotrons, a demonstration of shielded trochotron VS.10.H/M operating at 2 Mc/s with an oscilloscope display, in a varying magnetic field, and low voltage trochotron VS.10.K with 1 Mc/s transistor drive and transistor operated lamp readout.

3. Dekatrons, a dynamic demonstration of the new GCA.10.G dekatron with GR.10.H, digitron readout without the need for additional amplifiers.

4. Trigger tubes, a dynamic demonstration of a reversible trigger tube scaler using GPE.175.M tubes and coupling circuits using GTE.175.M tubes with transistor coupled digitron readout.

5. Spark gaps, a static display of GTR.30.W, all-glass precision primed diode, 30 kV $\pm$ 2 kV striking voltage, and also a static display of soldered ceramic tubes representing four different types, two diode gaps and two triggered gaps.

6. Stabiliser and reference tubes, a static display of some recently introduced voltage stabiliser and reference tubes, including two ruggedised tubes. Types include GD.90.M, GD.90.M/R, GD.83.M and GD.85.M/R.

Physics Division exhibits will include:

1. Demonstration of conveyor belt counting, using photoconductive cells as sensing elements, showing the use of phosphotrons in remote slave number displays.

2. Demonstration of the display of numbers and symbols using phosphotrons, Types P.20, P.21 and P.22.

3. Demonstration of a phosphotron alphabet display, Type P.40, controlled by remote push-button unit.

4. Static display of the range of standard phospholite panels, Types P.5, P.6 and P.7.

Evans Electroselenium Ltd.
Stand No. 12

The "Eel" Prothrombin meter has been designed to measure automatically the clotting time of plasma samples either by Quick's one-stage technique, Owren's P and P method or by the more recently introduced thrombotest. It operates on the principle of the photo-electric absorptiometer and provides a means of detecting the end point of clotting without the errors inherent in a visual assessment.

A new instrument, known as the Spectra, combines the simplicity and convenience of routine colorimetric equipment with the high performance and versatility needed for research.

The instrument is self-contained, incorporating a continuous spectrum wedge for accurate wavelength selection over the range of 400-700 mμ and employs only a single photocell at all wavelengths. It also incorporates a stabilising transformer. Interchangeable sample carriages are available for either test tubes or glass cells, in which the samples are contained. Provision is made for four containers to be inserted at the same time, thus permitting ready checking of either standard, "blank" or test solutions. A taut suspension galvanometer, fitted with zero and clamping controls, is fitted within the instrument case and readings are indicated on a clearly marked 15 cm scale.

The recording flame photometer has been designed primarily for the continuous measurement of sodium concentrations. With slight modifications it can also be employed for determinations of potassium, calcium and lithium. The instrument is completely self-contained, operating from a town or bottled gas supply. An air compressor with filter on the inlet side is fitted internally.

A chloride meter has been designed for the automatic determination of chlorides in serum. Only the operation of a single control is required to give a reading.

Electronic Instruments Ltd.
Stand No. 108

The Vibron electrometer, Model 62A, to be shown has nine ranges from 1 mV to 10 V, low effective volume of head unit, backing off facilities, and faster response.

Electrometer, Model 37D, is designed to measure ionisation chamber currents, high resistance and voltages derived from high impedance sources. With only one electrometer valve, the instrument is otherwise fully transistorised, working on one 12 V battery or a transistorised mains unit. It also easily mounts in an instrument rack. A 1 mA 350 ohm recorder output is provided.

Portable pH meter, Model 30B, is a redesigned model of a former E.I.L. portable pH meter. Transistors and a printed circuit make the instrument rugged and compact. It has completely automatic temperature compensation from 0 to 100°C, for changes in both the pH/e.m.f. characteristic and the zero of electrodes. The ranges covered are 0 to 7 pH, 7 to 14 pH, 0 to 700 mV and 700 to 1,400 mV, and the accuracy is within $\pm$0·1 pH or $\pm$10 mV.

The Vibron laboratory pH meter, Model 39A, has been developed for the precise measurement of pH. Besides the basic 0 to 14 pH range, it has two sets of expanded ranges. One has ten ranges with a scale length of 5 pH units, and the other fourteen ranges with scale length of 1·4 pH units. On the most sensitive ranges a discrimination of 0·005 pH is possible.

The E.I.L.-Haslam titration unit, Model B23A, is used with a direct reading pH meter and strip chart recorder to record titrations automatically. Since the rate of delivery of the titrant and the speed of the recorder chart are both constant, the system can be pre-calibrated so that the volume of titrant delivered during a titration can be accurately calculated from the distance travelled by the recorder chart. The unit has three delivery rates.

Portable X-ray dosemeter, Model 37C, uses one 12 V battery and but for one electrometer valve is fully transistorised. It has an improved zero stability and sensitivity. An output is provided for operating a 1 milliamp pen recorder.

Megohmmeter, Model 29D, has a combination of a test potential which is continuously variable from 10 to 1,000 V with direct reading of resistance at all voltage settings.

Direct reading susceptibility meter, Model 63A, is a portable instrument designed for measuring the magnetic susceptibility of para- and dia-magnetic materials and for testing samples containing ferromagnetic substances. It operates by detecting the change in reluctance of part of a magnetic circuit and may be regarded as a magnetic analogy of a balanced electrical resistance bridge.

The Vibron logarithmic electrometer will be shown coupled to a tissue equivalent ionisation chamber for monitoring neutron radiation fluxes.

The zero stability is better than 0·1 mV over 12 hours, and the input insulation resistance is 10^{16} ohms. A recorder/alarm output current of 1 mA for full-scale deflection is generated from a high impedance source.

The Serfass hydrogen purifier, capable of separating hydrogen from a mixture of gases and delivering it at a rate of 15 cu. ft per hour under pressure of 150 lb/sq in., will be shown. The hydrogen produced is so pure that impurities have not been detected even with the most advanced techniques of mass spectrometry.

Flann Microwave Instruments Ltd.
Stand No. 84

A coaxial line standing wavemeter, 4-12 Gc/s, consisting of a precision slotted coaxial line, terminated in high performance coaxial connectors, will be exhibited. The carriage supports a broad band tunable probe which has variable penetration.

Coaxial line thin film devices will be shown that utilise thin resistive films to achieve broad band characteristics, these include fixed attenuator pads, a termination and a power measuring head.

Microwave bench oscillator, CLX 4.2-12 Gc/s, is a coaxial line oscillator cavity utilising a plug-in klystron and is employed to generate the unusually wide band of frequencies. Power output from the cavity is through the tunable piston which operates as a bandpass filter. Great care has been taken to obviate mode crossings and "holes". Piston displacement is indicated on a dial calibrated in frequency.

Precision piston attenuator, CA/J2-15 Gc/s, is an orthodox type of piston attenuator, utilising an electroformed bore. Attenuation in decibels is read off directly from a large diameter dial gauge with an effective scale length of 180 in. representing 100 dB.

Several filters will be shown with various cut-off frequencies. Attenuations in the pass band are not greater than ½ dB and greater than 50 dB in the cut-off region.

A precision attenuator for 2 mm wavelengths (90-140 Gc/s), featuring freedom from backlash, 40 in. of scale length over entire insertion of metalised glass vane, will be exhibited. The instrument is of the flap type.

A high power calorimeter termination, 7-10 Gc/s, consists of two instruments, one a true calorimeter capable of use between 10 watts and 300 watts mean with peak levels of up to 300 MV, and the other a directly calibrated power meter working on the pressure build up in a closed system. The input voltage standing wave ratio is better than 0·95 over the entire frequency range.

Furzehill Laboratories Ltd.
Stand No. 10

The company's differential double beam oscilloscope has two identical vertical amplifiers providing differential input on each channel feed and a 5 in. flat-faced double gun c.r.t. Bandwidth/sensitivity is zero to 150 kc/s (3 dB) from 50 V/cm to 5 mV/cm; zero to 100 kc/s (3 dB) at 1·5 mV/cm, with common mode rejection better than 100 : 1.

The v.h.f. spectrum analyser operates in the frequency range 25 Mc/s to 140 Mc/s, and provides a panoramic display on a cathode-ray tube, over a frequency band variable between 0 and approximately 50% of the tuned frequency. Vertical deflection provides a logarithmic or linear display for amplitude evaluation.

The incremental inductance bridge comprises three units: the bridge, a variable d.c. polarising supply and an excitation oscillator. Measurements may be made over the range 50 mH to 500 H (alternatively 5 mH to 50 H) with polarising current up to 2 A and at any excitation frequency from 25 to 3,000 c/s.

The bridge incorporates a tunable frequency selective amplifier to ensure sharp null indication and gives a resistive balance from which Q may be calculated.

The excitation oscillator provides up to 10 watts via a matching transformer giving a number of alternative impedances.

The sensitive differential oscilloscope provides a maximum vertical sensitivity of 1·5 mV(d.c.)/cm and differential input facilities of particular value in the measurement of small potential differences which may themselves have a relatively high in-phase signal potential to earth.

A. Gallenkamp & Co. Ltd., and J. W. Towers & Co. Ltd. Stand No. 128

The automatic standard distillation apparatus originally developed by Shell has now been expanded and includes a refrigerator unit which is used to cool the condenser tank of the apparatus for the distillation of materials having highly volatile fractions. The recording and collection section of the apparatus is also provided with a supply of cooled air. The apparatus automatically records the correction temperature, the initial boiling point and the time taken to reach it, the vapour temperature against volume recovery curve, the time taken from the initial boiling point to final heat adjustment, the final boiling point and the time taken to attain it and finally the total recovery. During the distillation the recovery rate is automatically maintained within the limits permitted by specification.

Flame photometer (Gallenkamp)

A manipulator glove box has been developed for handling radioactive materials in a controlled atmosphere. Alpha or beta active substances such as C^{14} compounds which do not emit penetrating radiation can be safely and conveniently handled. A rubber sealed top window and long gloves are features of this box. The gloves are retained in place by means of rings which fit into grooves in the manipulator box. Thus the gloves may readily be changed without the use of tools. An air lock through which apparatus and reagents may be admitted is provided. Stopcocks control the inlet and exit of gas to the box which may be worked at pressures other than atmospheric.

There has long been a demand for a rapid method of determining directly the calorific value of foodstuffs. With the ballistic bomb calorimeter a determination can be completed in 5 minutes with an accuracy to 2%. The principle employed is that the sample is burnt in oxygen under pressure in a free standing bomb. A thermocouple inserted in the body of the bomb and coupled to a galvanometer is used to measure the peak temperature reached by the bomb. Comparative standardisation then enables calorific values to be calculated.

Lloyd apparatus is a compact instrument employing chemical methods for the determination of oxygen and carbon dioxide in gases. The apparatus features a multi-way stopcock which controls the operation and the flow of gas from the measuring burette into the absorption pipettes. The system is designed so as to be self-compensating for changes in ambient pressure and temperature. Using the apparatus, an analysis can be completed in 4-5 minutes with an accuracy to 0·01%.

A redesign of an earlier instrument, the flame photometer employs a built-in galvanometer and has been designed primarily for routine testing in clinical laboratories. Filters for sodium and potassium analysis only are fitted.

General Electric Co. Ltd. Stand No. 129
G.E.C. Semiconductor Division.
Stand No. 130

A selection of devices from a wide range of G.E.C. transistors, diodes and controlled rectifiers will be shown. In addition, a new range of general-purpose silicon h.f. transistors, known as ST721-3, will be displayed. These consist of n-p-n regrown-diffused devices for use at medium-to-high frequencies for small signal amplifier applications, and as general-purpose switching devices.

Silicon power regulators to be shown include the SZB series which covers the range from 15-33 V in 10% nominal voltage tolerances. Maximum power dissipation is 25 W for stud temperatures in the range −55 to +50°C.

Among silicon variable capacitance diodes on view will be the SVC11-15, 21-22 series. These are intended for use in parametric amplifiers and in similar applications at frequencies up to S-band.

A range of silicon p-n-p-n controlled rectifiers (SCR961-5) to be shown are for use in power control and power switching applications, requiring blocking voltages up to 200 V and load currents up to 10 A. The devices are of the three-junction type.

M-O Valve Co. Ltd. *Stand No. 129*

A new 20 W triode (E2910) capable of working up to 1,500 Mc/s, and for use under conditions of extreme vibration and shock, is to be exhibited. Another new transmitting valve to be shown will be a pulsed or c.w. oscillator triode (E2908).

The KT77, a new beam tetrode for use in high quality amplifiers, will be on view, and in addition two of the latest wide-band and low-noise valves. These are a high slope tetrode (D3a) for use in wide-band r.f. circuits and E2797, a low noise subminiature triode which has a noise factor of 1·7 dB at 48 Mc/s.

A new computer valve (A2900), a long-life double triode with close control of characteristics, will also be featured.

Three cathode-ray tubes shown will be the 900E (a 3½ in. version of the 5BHP), the 900F (a 3½ in. double gun cathode-ray tube), the characteristic of each system being similar to 5BHP, and the 1693L (a monoscope picture generator tube for test card "C"). Thyratrons to be displayed will include GT3, a modern version of the GT1C, with 6·3 heater, octal base and a smaller bulb.

G.E.C. Research Laboratories.
Stand No. 132

A range of thermoelectric cooling assemblies will be shown. These have cooling powers ranging from a fraction of a watt up to about 10 W when they are operated with a temperature difference across the junctions of 40°C.

Devices and apparatus incorporating the cooling assemblies will also be demonstrated.

Other items of research to be featured will be:

1. Magnetic films for information storage.
2. A high-efficiency post-deflection acceleration cathode-ray tube.

3. Recent developments in semiconductor devices and their applications.

4. The regrown diffused process for making transistors.

5. Iodine in tungsten filament lamps.

6. Fluorescent lamps operated from a d.c. supply.

7. Wide-band ferrite switch for use in X-band.

Griffin & George Ltd. Stand No. 600

A range of instruments for research, industry and education will be shown.

The Griffin gas density ratio monitor continuously monitors the gas concentration of a two-component gas stream. It uses a gas-density balance which measures the difference between the sample and a reference gas and relates them either by calibration or calculation.

The Griffin gas density balance chromatograph is for use with both analytical and preparative gas chromatograph columns. It consists of an oven containing the gas density balance detector, together with flow controls, gas sample introduction system, temperature measuring equipment, and an amplifier and recorder.

Other chromatographs to be shown include the flame-ionisation unit, an absorption chromatograph using carbon dioxide as the carrier gas, and a high-speed gas chromatoscope for the cyclic analysis of gas or vapour mixture.

An oscillating hotplate, Fisher pattern, is a combination of hotplate and oscillating unit which enables the heating and agitation of liquids to be effected simultaneously thus accelerating such processes as metallurgical and chemical analyses, determination of potash in fertilisers, acid values of fats, etc., and obviating the tedium of the manual work, will be shown.

Educational equipment will include the Clarkesmith low voltage power unit meeting L.C.C. Chief Engineer's specification for the provision of low voltage supplies with selection and control in the hands of the teacher; Mechtronics equipment for assembling experiments and demonstrations; a Van de Graaf generator and atomic models.

Guy's Hospital Medical School Stand No. 142

A radiofrequency electron spin resonance spectroscope will be shown. This spectroscope works on the same principle as the conventional 3 cm apparatus but at a wavelength of one metre and uses a quarter wave resonant line situated in a field of 100 gauss. Its chief advantages lie in the fact that it is much more portable than the high frequency apparatus and that at this lower frequency dielectric losses in water are reduced and hence large samples with a high aqueous content can be examined. The instrument is intended for investigation of free radicals produced by irradiation.

Hilger & Watts Ltd. Stand No. 133

The Ultrascan H999 will be featured on this stand. This is a double-beam recording spectrophotometer useful for routine analysis in the range from 200-750 mμ. Resolution is 0·1 mμ at 250 mμ and 0·2 mμ at 500 mμ. Two light sources are used, one for the ultra-violet region and one for the visible region. These are a hydrogen lamp and a tungsten filament lamp respectively, and they change over automatically at 350 mμ where their spectra overlap, enabling a complete scan to be taken right through the range without a break. The flat-bed recorder has three scanning speeds.

The Arndt single crystal diffractometer will also be on view. This linear diffractometer automatically measures X-ray reflections from single crystals. Once the crystal has been set up, reflections are recorded in logical order as they occur on reciprocal lattice lines, and when one level has been so recorded a single adjustment sets the instrument for the next level.

The Fluroprint Y150 to be exhibited is a fully automatic X-ray fluorescence vacuum spectrometer for the routine analysis of large numbers of samples in solid, liquid or powder form. All elements with an atomic number higher than 12 (Mg) can be analysed, and the results are printed automatically in tabular form on a digital typewriter. Up to twenty elements can be programmed at one time.

A further exhibit will be the new Fluorimeter H960, a robust instrument suitable for a wide range of routine analyses, designed for simplicity of operation and convenience of sample interchange. Special features are high sensitivity and low instrumental blank. Standard cells, low capacity cells or siphon-type flow-through cells can be accommodated.

An electroformed waveguide for the O-band will be shown. A comprehensive range of microwave components based on the same waveguide aperture size (0·122 in. × 0·061 in.) is under development. Examples of these 4 mm components on display will include a matched hybrid tee, a micrometer short-circuiting plunger with a phase shifter (moving dielectric vane) and various attenuators.

The Microspin is also to be displayed. Electron spin resonance spectrometers using microwave frequencies in the Q-band and the X-band are being developed in co-operation with Microwave Instruments Ltd.

In the photoelectric microptic polarimeter, M511, to be exhibited, the optical scale is read visually with a microscope, but a photoelectric setting with an accuracy of 0·005° over 90° has been provided on the extinction angle. A precision of ±0·002° can normally be achieved without fatigue and without the possibility of faulty judgment. An optical element is used both as a chopper and to provide a double-beam-in-time system.

Further equipments to be displayed are:

1. The Duochromator, E222, a two-channel direct-reading spectrometer intended mainly for instruction on direct-reading spectrochemical analysis in universities, technical colleges and similar institutions, but suitable also for some simple analyses in industry.

2. High-power Microfocus unit, Y33, which has interchangeable guns which give focal spots of the following sizes and powers:

(a) 40-microns diameter, 50 kV d.c., 400 A
(b) 1·4 mm × 100 microns, 50 kV d.c., 3 mA
(c) 6 mm × 100 microns, 50 kV d.c., 10 mA.

This versatile unit has a high-power transformer, a demountable tube and anode assembly which includes an efficient cooling system, and a redesigned water-jacketed focusing gun to produce the large spot. The unit is useful as a source for a diffractometer. High resolution is obtainable even at fast scanning speeds because of the high power and fine focus.

3. The Colourmeter, J40, which measures surface colours in terms of the internationally recognised C.I.E. system —standard illuminants B and C of that system are available. Readings are taken direct from a potentiometer scale. Accuracy in absolute measurements is within ±0·005 in. in chromaticity coefficients for most colour surfaces except very dark or very saturated ones.

4. Hollow-cathode lamps for atomic absorption.

5. Comparator-microphotometer, L90, a combined instrument which provides high precision, rapid scanning, and ease and comfort in reading. The reference and unknown spectra are shown on two halves of a bright screen, enlarged fifteen times.

6. Grating monochromator, D290, a simple monochromator which uses a grating of 15,000 lines to the inch and gives a reciprocal dispersion of 70 Ångstroms per millimetre. The wavelength is adjustable from 2,000 to 10,000 Ångstroms, and is controlled by a knob with an indicator reading to 10 Ångstroms.

International Computers and Tabulators Ltd. Stand No. 2

A demonstration will be given of the magnetic hysteresis loops which can be obtained when fields are applied at various angles to the preferred direction and the flux is cut in line with and at right angles to the applied field. The hysteresis loops observed can be compared with those predicted by a theoretical analysis.

A demonstration of the Kerr magneto optic effect will show how the coherent rotation process can be exploited so that magnetic films can be used to store information in binary form.

A magnetic film digital store will also be featured. An experimental 2,500 bit device arranged to store 50 words each of 50 bits is of the matrix type which exploits the coherent rotational mode of switching. It can be operated with a cycle time of a fraction of a microsecond. The ultimate switching speed of the magnetic film is thought to be less than 1 μ sec (10^{-9} sec).

The magnetic film store plate tester to be displayed is an apparatus which is fully transistorised, and is virtually part of a computer using a thin magnetic film store. The tests are designed to simulate operation in a computer store and are arranged so that the plate may be quickly accepted or rejected for assembly into a store.

Complete tests on all 1,250 storage elements on a store plate can be made in a few seconds. This development is part of a programme being carried out in co-operation with The General Electric Co. Ltd.

Isotope Developments Ltd. Stand No. 41

Exhibits on this stand will be:

1. Chromatogram scanner, which

measures chromatogram strips labelled with radioactive isotopes such as C14.

Two versions are available, one using a windowless scintillation counter and the other using two 2 in. window G.M. tubes thus providing 4 π geometry.

The paper feed mechanism provides six speeds of traverse between 1 in. and 12 in. per hour and is driven by a synchronous motor so that when used in conjunction with a synchronously-driven recorder the resultant chart may be aligned exactly with the chromatogram.

2. Co-incidence scintillation counter, Type 2022, an equipment which has been designed to meet the requirements for measuring milli-micro-curies of low-energy-beta emitting isotopes. It incorporates two photomultiplier tubes which view a mixture of the sample with a liquid scintillator. The amplified signals from the tubes meet in a co-incidence circuit where thermal noise is rejected. Background counts of approximately 1 per second and efficiencies of about 12% are obtainable with tritiated water.

3. Geiger - Müller tube counting assembly, comprising a Geiger-Müller tube, housed in a lead castle, Type 710, which works into a quench unit, Type 667, which in turn drives a scaler, Type 1805. The lead castle provides both shielding for, and protection from, the radiation to be counted by the G.M. tube. The quench unit has a variable switch-selected quench time to accommodate various types of G.M. tube and 10 V amplitude, positive-going or negative-going output. The scaler, Type 1805, with a maximum count of 99,999 pulses and a resolution time of 275 μs, provides the power supplies for the quench unit and high voltage, continuously variable from 300 V to 2,000 V, for the G.M. tube.

4. Double channel pulse-height analyser, a scintillation counter, Type 663, fitted with a well scintillator and housed in a shield, Type 722, works into a double-channel pulse-height analyser, Type 6005. The shield provides both shielding for, and protection from, the radiation to be counted by the scintillation counter. The double-channel pulse-height analyser comprises two amplifier-selectors, Type 1830, each driving a scaler, Type 1800. A ratemeter, Type 1815, provides the high-voltage, continuously variable between 300 V and 2,000 V, for the scintillation counter and facilitates setting-up. The five 1800 Series units are housed in a 3 ft, forced-ventilated rack.

5. Alpha spectrometer assembly, comprising a windowless scintillation counter, Type 6001 (a drawer unit, Type 723, fitted with a scintillation counter, Type 663) is provided with a thin caesium iodide scintillator to detect alpha particles. The scintillation counter 663 works into a head amplifier, Type 668, which drives a pulse-height analyser, Type 1870, which, in turn, drives a ratemeter, Type 1810.

6. Automatic sample handling and recording—the automatic sample changer, Type 2014, handles up to 50 standard 1 in. and 2 in. planchets which are offered in turn to a radiation detector and then may be restacked in their original order so that they may be re-measured, as in half-life assessments. The detector works into a scaler, Type 1700, which provides all the facilities necessary for both scintillation counters and Geiger-Müller tubes and which can be set-up to terminate an observation when a pre-determined number of counts have been recorded or when a pre-determined time has elapsed, whichever event is first to occur. The whole system is controlled by the print-out unit, Type 2007, supplies for which are provided by the scaler, 1700. When the scaler terminates a counting period, the print-out unit interrogates the scaler, prints the count, the elapsed time and the sample number, re-sets the scaler and initiates the transfer and counting of the next sample.

7. Health and safety-area monitor—an electrometer, Type 1880, will be used to measure the current caused to flow through a gamma-sensitive ionisation chamber by the background radiation in the exhibition area. A permanent record will be made by a chart-recorder actuated by a signal from the electrometer.

Kelvin & Hughes Ltd. Stand No. 104

A new type altimeter, designed to meet the needs of contemporary high-flying, high speed aircraft, and a new pen recorder which offers a choice of either curvilinear or rectilinear traces are two new developments to be shown by Kelvin Hughes.

The stand combines exhibits from Smiths Industrial Division and Kelvin & Hughes (Aviation) Ltd.

The precision altimeter consists essentially of two parts which are mechanically separate, but electrically connected.

Pressure measurement is effected by a force balance unit, the output of which is transformed mechanically by means of a cam from pressure to height. This output is then corrected for position error using a computing circuit which is fed from a transmitting machmeter. The computing circuit is so designed that error effects due to incidence can also be corrected if required.

The precision tachometer provides an accuracy of 0·1% or better, effects a considerable reduction in weight and abolishes the need for a reduction gear between the engine and speed measuring element.

A series of fluxgate elements will be shown, which may be applied to a wide variety of instruments for detecting or accurately measuring magnetic field strength and/or direction.

The elements require to be energised by application of a small a.c. supply at 400 c/s or 1,000 c/s, which saturates the high permeability core over parts of each cycle; a second-harmonic output is generated in a secondary winding, and this output depends, in voltage and phase, on the magnitude and direction of the magnetic field in which the element is immersed. Outputs up to 3 volts per oersted may be obtained, and units may be made suitable for operation over a temperature range of -75 to $+120$°C.

Acceleration/inductance transducers have been developed for the Ministry of Aviation. These miniature accelerometers are of the single-wound, variable reluctance type, and are available with alternative windings giving either 5·5 to 7 mH or 2 to 2·5 mH at the lower limit of the "g" range.

They are intended primarily for use in frequency modulation circuits, and the full-scale frequency change is -28 to -30 kc/s in a 160 kc/s carrier.

Twenty ranges, from 0 to 3 "g" up to 0-80 "g", and from ± 2 "g" up to ± 30 "g" have been designed.

A miniature force balance system, consisting of a versatile pressure transducer in which the capsule output force is balanced by a precision spring and servo-driven lead screw, will be shown. The rotation of the lead screw is a direct function of pressure change, and can be made to operate dials, counters, remote indicating transmitters, computers, or digitisers.

With the introduction of instrument systems using very accurate Pitot-static sensing equipment, a need has arisen for a portable test equipment of similar accuracy. Kelvin Hughes have developed, in collaboration with the Ministry of Aviation, a portable test set which can be used to test air data systems, and other Pitot-static systems such as those in power control equipment, etc.

This Pitot-static test set comprises two accurate pressure transducers, control valves, fine adjusting bellows, Pitot head adaptor and dual purpose hand pump. The overall accuracy of both outputs is $\pm 0{\cdot}015$ in. Hg.

True airspeed can be expressed as a function of Pitot pressure, static pressure and indicated airstream temperature.

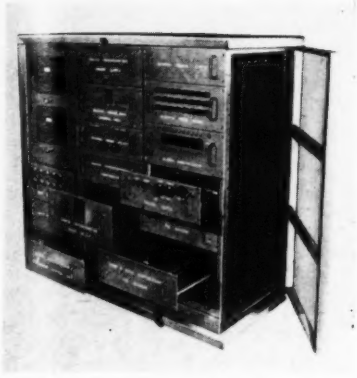
The function of the true airspeed computer is to measure these three parameters and from them compute true airspeed, mach number and air miles flown. The pressures are measured using a force balance unit. This type of transducer, in which the force output of a capsule is balanced by the force exerted by a precision spring, measures pressures to a high degree of accuracy and provision is made in this computer to correct for pressure error (caused by pressure at the pressure head not being exactly equal in true values). Indicated temperature is measured using a wire thermometer bulb and is corrected within the computer to give true airstream temperature.

Among the industrial products to be shown will be a data handling system designed to give the greatest flexibility of application and capable of scanning and logging an unlimited number of process variables. The application potential of this system is only limited by the availability of suitable transducers.

The standard input is a d.c. voltage or current and suitable transducers are readily available for applications involving pressure, flow, strain, pulsed and a.c. outputs. Thermocouples or resistance thermometers serve temperature applications and cold junction compensating units are provided for each type of thermocouple input.

Presentation of information is in digital form throughout. High and low limit checking with alarm indicators, range variations, zero suppression and inbuilt linearisation as required for thermocouples, flow, etc., are available for integration into the scanning sequence. Logging is by electric typewriter on blank or pre-printed log sheets, off-normal points being printed in red.

A digital voltmeter is used to measure the process variable and present the result in digital form. It contains a sequencing unit, relays, two state amplifier and power



Data handling system (Kelvin Hughes)

supplies. The latter includes a supply stabilised within 0·05% for measurement reference purposes. Voltages are sequentially switched and compared with the input voltage until a final out-of-balance value within 0·1% is achieved.

The system, including transducers and power supplies, is housed in a cubicle-type panel, the units being rack-mounted for ease of servicing.

A rectilinear recorder is now being offered as a universal instrument in that an extremely wide range of paper speeds will be available and that any number of channels up to a present maximum of 12 can be fitted. This latter advantage is made possible by constructing each channel as a complete magnet system and galvanometer movement.

Possibly the most outstanding feature of this instrument is the choice of either a curvilinear or rectilinear trace. The rectilinear trace is produced by running the paper over a knife edge and fitting the pen with a long writing element. Electrosensitive and heat sensitive papers also can be used in this instrument.

The gear box is provided with an electrical gear change which is actuated by means of press buttons and, therefore, remote control of the recorder is made possible.

Lintronic Ltd. Stand No. 32

The company's transistorised commutator for mV signals has a switching rate from 1 to 20 kc/s and 10 channels. The input ranges are from ±10 mV to ±100 mV. Each switch has an exponential approach to true value less than 10 microseconds. The linearity is within 0·1%.

A transistorised Eccles-Jordan bi-stable circuit memory store for a digital data recording system will be shown. Twelve flip-flops with visual indication are built on one printed circuit module for plug-in on to 0·20 in. pitch edge-plug connectors.

A transistorised pulse pattern generator, a differential pressure pulsating flowmeter and a turbulence detector will also be shown.

Marconi Instruments Ltd. Stand No. 98

Examples from the Marconi Instruments range of telecommunications measurement equipment will be shown, including two new instruments—the low-frequency generator TF1382, and the suppressed-zero voltmeter, TF1377. Representing the company's industrial range of equipment is the new laboratory pH meter, TF1093, a mains-operated high-stability instrument covering the range 0 to 14 pH.

The low-frequency generator, Type TF1382, delivers any of three switch selected waveforms—sine, square, or ramp, and is continuously variable over the frequency range 0·0033 c/s to 1 kc/s. This frequency range is covered in five over-lapping bands. A built-in relay with heavy-duty change-over contacts wired to the front panel is operated by the squarewave output at frequencies of up to 1 c/s; this enables external devices to be switched on and off in a cyclic manner at the operating frequency.

The usefulness of this instrument as a timer is greatly increased by the provision of facilities for "single-shot" operation. The timing cycle is initiated by a switch on the front panel, by an externally-generated pulse, or by external shorting contacts.

The suppressed-zero voltmeter, Type TF1377, is a potentiometric slideback voltmeter for measuring absolute voltages up to 500 volts d.c. and changes as low as 1 mV in the source under test. It can also be used as a conventional differential voltmeter with a range of ±1 mV to ±50 volts.

In the slideback or suppressed-zero mode of operation, the source voltage is backed off against a potentiometer-controlled internal d.c. supply, using the centre-zero meter as null indicator. The absolute voltage of the source is indicated by the digital readout of the potentiometer and subsequent variations in voltage are, shown on the meter. Small changes in large voltages can thus be measured with exceptional discrimination, accuracy and ease, avoiding the inconvenience of using complicated arrangements of external batteries for backing off the standing voltage.

In the differential mode, the potentiometer is switched out of circuit, and small unknown voltages are indicated directly on the meter.

Suppressed zero voltmeter (Marconi Instruments)

10-Mc/s electronic counter, Type TF1345, is a high-speed counter/timer with built-in precision frequency standard. Readout is by neon indicators on an 8-decade digital display. The instrument counts up to 10^7 per second; measures frequency from 10 c/s to 10 Mc/s, period of waveforms up to 100 kc/s. Selection of plug-in accessories extends frequency range to 220 Mc/s, allows time measurement down to 1 μ sec, increases sensitivity to 10 mV. Display time: manual, or continuously variable from 0·1 to 10 seconds with automatic and repetitive resetting. The equipment is available for bench or rack mounting.

Laboratory pH meter, Type TF1093, is a mains-operated high-stability laboratory pH meter, providing a direct reading of pH from 0 to 14. Any section of the scale can be expanded over a centre-zero incremental range of ±1·4 pH, enabling small changes in pH to be measured with a discrimination of better than 0·01 pH; the main and incremental ranges are provided with independent buffer controls to enable accurate cross-correlation to be carried out. There is a ±2 pH increment switch for buffer solution extension or self-check. Full automatic compensation for solution temperature is provided on both ranges.

The instrument also measures voltages in the ranges 0 to 1,400 mV and ±140 mV with the same high input impedance and stability as for pH measurement. This extends its use to such applications as rH or corrosion-potential measurements.

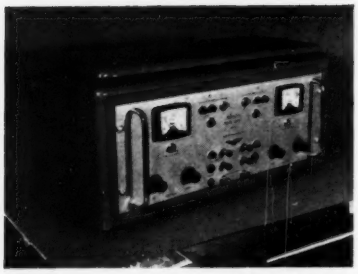
Marshall of Cambridge Electronics Ltd. Stand No. 117

An improved multichannel pulse height analyser, using the Hutchinson-Scarrot principle, will be shown. Analogue and digital displays are provided, and readout facilities are provided in both analogue and digital form. Additional facilities provided are automatic background subtraction, exponential energy scale and coincidence and anticoincidence arrangements. A total counts scaler and live time integrator are provided.

The first of a new range of transistorised counting and timing devices based on a decade counting ring using a minimum number of transistors is the scaler, Type 200. The scaler contains a discriminator, six scaling decades, and a power unit; indication of count is provided on six meters. A variable paralysis time is incorporated in the discriminator, having a minimum value of 1 microsecond, and a comprehensive gating system is provided. Plug-in power units enable the instrument to be run either from batteries or any normal mains supply.

Based on scaler, Type 200, the counter timer, Type 202, uses a temperature-controlled 1 Mc/s crystal as a time standard. The controls provided enable the instrument to be used to perform accurate time and frequency measurements. Facilities for counting random or periodic signals are included, and frequency division may be accomplished in decades from an external signal of frequency not exceeding 1 Mc/s. The decimal submultiples of the 1 Mc/s standard are available as reference frequencies.

The Magnetic pulse recorder, Type MPR103, is a transistorised instrument



Transistor power supply (Marshalls of Cambridge Electronics)

which has been designed to enable pulses from nuclear radiation detectors to be permanently recorded in analogue form. The pulse spectrum may then be played back into a pulse height analyser to enable the energy spectrum of the radiation to be examined. A wide range of recording speeds is provided so that at low counting rates, pulses may be recorded for up to approximately 80 hours on a standard 1,800 ft reel of ¼ in. tape. The record is always played back at maximum speed so that the playback occupies approximately 24 minutes.

In the twin channel pulse generator, Type TPG102, the two channels have independent controls in amplitude, polarity, pulse duration and delay relative to a pre pulse. At amplitude up to 5 volts, the pulses have a risetime of 20 ns, at an impedance level of 100 ohms. Amplitudes up to 50 volts are available at 1,000 ohms impedance level. Amplitude, duration and delay are all continuously variable, as is the common repetition frequency whose maximum value is ½ Mc/s. The pulses from the two channels may be separate or mixed.

The company will also be showing a range of transistorised power supplies.

Megatron Ltd. Stand No. 45

A range of different shapes and sizes of mounted and unmounted selenium photocells with different spectral characteristics will be shown. Improved "potted" selenium cells, tropical fast and resistant to chemical attack, will also be shown.

Besides the well-known range of cosine corrected light meters C1-C3 and C5a, an integrating light meter developed in co-operation with National Institute of Agricultural Engineering will be shown.

The colour temperature meter used by photographers and in colour printing, and samples are shown of three different types of coatings on glass which are being used on antistatic instrument windows and for de-misting and de-frosting, electro-luminescence, etc., will also be shown.

Mervyn Instruments Ltd. Stand No. 119

The Mervyn - Harwell square wave polarograph Mark III in its latest form incorporates the greatest convenience for the operator in use. A thermostatically-controlled cell holder is built in and contains four Barker-type cells and twin dropping electrodes. All the features of previous models have been incorporated in the Mark III design, and the complete unit is engineered for accessibility in servicing. Built into the instrument is a source of electrolytic hydrogen for de-oxygenation. This is arranged, however, in such a way as not to preclude the use of other deoxygenation gases such as white spot nitrogen.

The Mervyn plant stream gas analyser Mark II will measure and record the amount of one component in a multi-component gas stream. The gas stream is sampled and passed through an absorption column where it reacts with a suitably chosen reagent.

Typical performances range from 10 parts/million full-scale deflection ±2% to 50,000 parts/million full-scale deflection with an accuracy to ±0·5%. Gas consumption is 20-30 litres per hour at 4-5 ft water gauge but other conditions can usually be accommodated.

In giving a demonstration of infra red spectra to a large audience it became obvious that the 10 in. wide chart of a conventional potentiometer recorder would be insufficiently visible. The recorder shown has a chart width of 30 in. and a full scale response time of ¼ sec. A simplified method of advancing the chart, which is a single sheet of paper, is used, and the trace is made by a felt tipped pen. The servomotor is driven by a simple direct coupled amplifier and the electronic circuitry generally follows conventional lines. The plotter which is shown working is in the form of a laboratory assembly and was designed and manufactured for the lecture in three weeks.

Examples will be shown of synthetic materials produced by the Bridgman-Stockbarger process. They are principally halides of the alkali and alkaline earth metals.

In the Mervyn portable transistorised self - balancing potentiometer recorder shown, the chopping unit uses transistors as does the amplifier, demodulator and output stages. The voltage reference is a Zener diode and the rectilinear potentiometer is driven from a miniature d.c. motor. The power supply is by 2 × 4½ V dry batteries and the chart drive is by 8-day clockwork movement.

A non-overloading high speed pulse amplifier will provide a voltage gain of 60 ± 2dB from a 100Ω line into a 250 pF load developing between 5 and 55 volts output with a linearity to better than 2% and a rise time shorter than 120 milli-microseconds.

The amplifier comprises a number of stages of the Chase and Higginbottom type driving a White cathode follower output. The amplifiers, time constant controls and a well-regulated power supply are all housed on a 19 in. chassis. The design of this amplifier is due to the Atomic Weapons Research Establishment, Aldermaston, Berks.

Metals Research Ltd. Stand No. 95

The Pyrotube is a high temperature heating element capable of heating furnaces to 1,800°C. The element consists of a molybdenum heater which is sheathed by a pure recrystallised alumina tube. The impervious sheath is sealed at the lower end and closed at the top by an appropriate header which contains the electrical terminals and the connections for the protective gas supply. Cylinder hydrogen is used at very small flow rates to prevent oxidation of the molybdenum, and is confined within the Pyrotube. The heated zone starts three inches from the bottom and extends upwards for six or twelve inches in the two standard types.

Many types of metallic single crystals will be exhibited including those grown by Bridgman, Czochralski, strain-anneal and floating zone methods.

The Servomet spark machine is an adaptation of the spark erosion process for use in metallurgical laboratories. This instrument has been used extensively by Metals Research and has proved an invaluable means of rapid, accurate and strain-free machining of all types of metallurgical specimens.

Morgan Crucible Co. Ltd. Stand No. 36

The exhibits to be displayed on The Morgan Crucible Company's stand illustrate some of the techniques and materials developed by The Morgan Crucible Group. The instruments exhibited have been constructed for internal research purposes only, but the materials and devices shown can be supplied in commercial or experimental quantities.

New couple elements are being developed for peak temperatures in the range 1,600°C to 2,000°C or higher, in which conventional metallic couples fail. Some of the materials, being semiconductors, provide a very high voltage output, compared with metals. For example, a silicon carbide-graphite couple can be made to give 0·2 volts at 1,000°C.

Modification of the properties of silicon carbide and graphite, by controlled adjustment of composition, allows couples to be made from two types of silicon carbide, or two types of graphite. Alternatively any of these materials can be run against a refractory metal such as tungsten or rhenium.

The "Crusilite" silicon carbide electric heating element has been adapted to produce a heater for sealing transistor envelopes or other small electric components. The component to be sealed is placed in the centre of a small ring heater, providing a concentrated source of heat radiation to the required area.

Waveguide loads (Termilode) have been designed to enable a radar station to "stand-by" or "test" on full power without transmitting a signal by which it can be detected, and without interference to other stations. Unlike previous materials used for this purpose, "Termilode" which is based on silicon carbide can dissipate kilowatts of energy. The temperature limitation is set more by ionisation of gas in the waveguide than by the material of the load. 1,000°C will give a satisfactory performance. The various designs shown (with overall lengths varying from a few inches to several feet) are intended for air or liquid cooling. Dissipation up to 8 kW has been achieved by water cooling.

"Morganohm" grade 9 non-linear resistors may be used for volume compression for telephone engineering, transistor and meter protection and function generation. These resistors are made from a new material which extends the existing range of non-linear resistors. The current varies as the voltage raised to the 4·5 power.

A technique has been developed to follow under a microscope the slow changes

in crystal form, or other visible qualities of solid materials. The material is placed on an electrically-heated metal strip and illuminated by ultra violet light. A camera gun is used to photograph the changes at minute intervals, and the film is then run at normal rate.

A dynamic electronic furnace analogue demonstrates the ease with which a complicated furnace design can be modelled electronically. Many of the refinements of large analogue computors are omitted, but the model can take into account the heat flow through the various assemblies of refractory insulation in the walls, roof, and doors of the furnace. It can also allow for storage of heat in the walls, and the very large losses of heat in exhaust gases. The model will provide information on fuel input and on the working temperatures at any point in the refractory walls by automatically following a speeded up version of the full-scale cycle.

Muirhead & Co. Ltd. Stand No. 28

An instrument for the automatic analysis and graphic recording of all types of noise and vibration signals from "live" or magnetic tape recorded sources will be shown. The equipment performs amplitude/frequency analyses of steady signals and amplitude/frequency/time analyses of non-steady (time-varying) signals and is fully automatic over the entire frequency range of 10 c/s to 19 kc/s. To save time, the equipment can be made to scan only part of this frequency range if required. Three degrees of selectivity (1/3 octave, 5% and 1·5%) are available and in each case, the percentage bandwidth is constant at all frequencies; discrimination against unwanted frequencies is high. The maximum frequency error on the pre-printed output record paper does not exceed 1%. Input signals can be in the range 10μV to 300 V and with the input attenuator set for automatic operation a dynamic amplitude range of up to 70 dB can be handled.

The precision r.m.s. decade voltmeter (D-930) has the wide voltage range of 1 mV to 300 V and the wide frequency range of 5 c/s to 100 kc/s. Over the greater portion of these ranges, the measurement accuracy is to 0·05%—even at the supply frequency. Maximum sensitivity is 0·025% for all readings.

The high frequency analyser-oscillator (D-888) has a frequency range of 200 c/s-650 kc/s, and can be used as an analyser (with a Q-factor of not less than 70 and an octave discrimination of about 40 dB) or as an oscillator (with an output of 2·5 V (10 mW) into 600 ohms).

The precision decade oscillator (D-890) has the wide frequency range of 1 c/s-111·1 kc/s and a crystal check facility which at spot frequencies gives a setting accuracy to 0·005%. Other features include purity of waveform and frequency stability which are assured by the use of controlled negative feedback in the oscillator section; this also makes the instrument particularly easy to use—there is no "set zero" or "oscillator drive" control to adjust before operating the instrument. Frequency selection is by four decade dials and a fine trimmer. Over most of the frequency range an output of 2 watts (126 V) into 8 k ohm is available; 1 watt (25 V) into 600 ohms is also available down to 300 c/s.

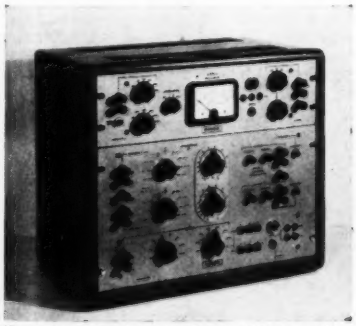
Intended for testing the frequency response and stability of automatic control (servo) systems, the Muirhead transfer function analyser enables measurements to be made between any two points in a system over the range 0·5 c/s to 10 kc/s. Ancillary equipment enables the transfer function analyser to be used with a.c. carrier type servo systems employing synchros or magslips at frequencies up to 20% of the system carrier frequency.

Results are obtained directly in polar form so that frequency plots (e.g., Nyquist diagrams) can easily be drawn.

Three new transistorised units will be on display: a 50-60 c/s servoamplifier (D-985) for supplying the centre-tapped low voltage control winding of a servomotor: a 400 c/s feedback resolver amplifier (K-29); and a tuning fork unit (D-936) which is available at any frequency in the range 400 c/s-2,400 c/s.

New servo components on display this year are: size 11 synchros, satisfying the latest American specification MIL-S-20708A. Size 08 motor tachometers 400 c/s. Size 11 motor tachometers 60 c/s and 400 c/s.

Also on show are two items of test equipment for torque receiver testing; a fully automatic receiver following accuracy test set for 60 and 400 c/s receivers, sizes 11 to 23, providing a permanent chart record of the following error; and a unique synchronising time indicator for measuring the settling time of any type of receiver.



Transfer function analyser (Muirhead)

N.G.N. Electrical Ltd. Stand No. 83

Pumps and pumping units, magnetic vacuum valves, vacuum gauges and demountable unions and couplings will be shown.

Samples will be shown of single and two stage gas ballasted rotary piston pumps on which the piston has been replaced by a sliding vane with the inlet and outlet parts disposed immediately on either side of the vane. Thus on two-stage pumps the inter-stage connection can be provided via the plate separating the stages.

The pumping units include a combination pumping unit comprising 3 in. diffusion pump baffle valve and backing pump, the operation of which is controlled completely by movement of the baffle valve handle. A single handle control on the baffle valve operates the raising and lowering of the baffle plate which is interlocked with the roughing valve and also operates micro-switches which control the operation of the magnetic isolation and air admittance valves. A water flow relay is fitted, together with a protection unit which ensures that on a short term mains failure and subsequent return the unit shuts down and re-starts automatically in the correct sequence protecting at all times the work in the vacuum vessel.

National Research Development Corporation Stand No. 139

Among the exhibits will be a stereoscopic rangefinder and a frost point hygrometer.

The stereoscopic rangefinder indicates three distances simultaneously. These distances are a range, which can also be read from a scale, and the far and near limits of depth of field of a camera lens, having a certain aperture diameter, focused to that range.

There are two main controls: one which alters the range and could be coupled to the focusing mechanism of the camera lens, and another which varies the apparent distance between the near and far depth of field distances in the correct manner, and could be coupled to the stop adjusting mechanism of the camera lens.

There is automatic compensation for varying eye separations of different observers.

Experiments show that trained observers can achieve a standard deviation of 0·5 in. on a target at 10 ft. Untrained observers have standard deviations of 0·6 in. at the same range.

The instrument is the invention of Mr. N. P. Barton of the Fighting Vehicles Research and Development Establishment and is the subject of Patent Application No. 34,653/58. It is being exploited by the National Research Development Corporation.

The normal frost point range of the R.A.E. hygrometer is about 0 to −60°C using a coolant of dry ice (CO_2) and alcohol mixture but using a liquid air or liquid nitrogen coolant the range can be extended down to −100°C or lower. The instrument is very sensitive possessing a time constant of a few millisecs whilst frost point accuracies of better than ±0·5°C can be obtained.

The instrument is a continuous sampling device, but it can easily be modified to sample fixed quantities of air. It has also been constructed so as to indicate the frost point temperature on a meter but again it can easily be modified to provide a record or control other equipment.

The basic principle of the R.A.E.-hygrometer is similar to many other dew point hygrometers where the measurement of relative humidity or dampness ratio is resolved into the measurement of two temperatures:

1. The actual air temperature
2. The dew point temperature.

In the R.A.E. hygrometer the dew point temperature is the temperature at which frost just begins to deposit on a mirror, because of the very low humidities covered by this instrument.

The instrument has a continuously-running refrigerator working at a temperature at least 10°C below the minimum frost point temperature being measured.

This temperature is obtained by the reaction of dry ice and alcohol, or with liquid nitrogen or liquid air. A copper slug is inserted in the refrigerator to cool by conduction a small mirror made of constantan metal which is rhodium plated. This mirror is placed in the air stream under test, in such a manner that frost deposited upon it can be observed through an optical viewer. Air under test can be drawn across the mirror with the aid of a small pump. The viewer also enables the auto control to be set up and enables the instrument to be used under manual control. The surface of the mirror, which is highly polished, is illuminated obliquely by a lamp and a lens system. A photocell views the mirror surface through another lens system and only detects scattered light from the surface. A second photocell is illuminated directly from a lamp through an adjustable aperture. The outputs from the two photocells are then compared and the output is used to modulate the amplitude of an oscillator. The output of the oscillator is then rectified to produce a d.c. signal which controls an r.f. eddy current heater, the output coil of which is wound directly onto a high loss bobbin surrounding the copper slug in very close proximity of the mirror assembly. Thus the temperature of the mirror is accurately controlled by the photocells at the frost point of the air under test. The temperature of the frost point is then measured by the thermo-electric effect produced by the constantan mirror and the copper slug. To avoid the mirror assembly becoming overheated when the refrigerator is short of coolant a thermal cutout makes the eddy current heater inoperative.

New Electronic Products Ltd. **Stand No. 62**

Temperature stabilised pressure transducers will be shown.

These transducers are produced as two distinct types for single ended or differential pressures. Both types operate on a variable inductance principle and are intended to be used with a carrier system and high speed recorder.

The differential pressure transducer incorporates two arms of a bridge and is available for pressure ranges from 0 to $\pm$5 lb per in^2 to 0 to $\pm$5,000 lb per in^2. The single ended transducer incorporates all four arms of the bridge and is, therefore, not affected by the length of connecting lead. This transducer is available for pressure ranges from 0 to 5 lb per in^2 to 0 to 10,000 lb per in^2.

Since production started on these two transducers temperature stability has been improved to withstand up to 200°C with less than 0·01% zero drift per 1°C.

Plating of the component parts with a variety of materials will allow the transducer to be used with most pressure media.

A miniature differential transducer operating on a variable capacity principle has been designed for applications, such as wind tunnels and model testing, where small size is important and high pressures are not likely to be encountered. The pressure range is 0 to 4 lb per in^2 with a linearity better than 1·5% of full-scale deflection. Up to four transducers may be packed into an area of 1 in^2.

A pressure transducer for use with radioactive media consists of a single-ended variable inductance type transducer with provision for backing off with a calibration pressure. The working range is from 0 to 5 lb/in^2 but the construction is such that should the diaphragm be burst by excess pressure the radioactive fluid will be contained. The device is safe for excess pressures up to 10,000 lb/in^2.

A development of this transducer is also available for medical purposes.

A package unit has been developed to reduce the cost of operating inductance type transducers which have a high output and consequently do not require amplification when the signal is to be fed into a galvanometer recorder.

The unit comprises a d.c. stabilised oscillator supplying 3 kc/s at 12 volt r.m.s. to the external bridge (transducer). The modulated output from the bridge (transducer) is fed back into the demodulator section of the package unit from which a d.c. output is available for a galvanometer recorder.

The package unit has an approximate output of 0·75 mA into 100 ohms and is stable within 1% over a temperature range of 20 to 60°C.

A miniature electrocardiograph, a high frequency pen recorder and an ultra violet pen recorder will also be shown.

Newport Instruments (Scientific and Mobile) Ltd. **Stand No. 22**

A demonstration will be given of the measurement and adjustment of the field homogeneity of an electromagnet, using instruments employing nuclear magnetic resonance and electron spin resonance techniques which have been developed for this purpose.

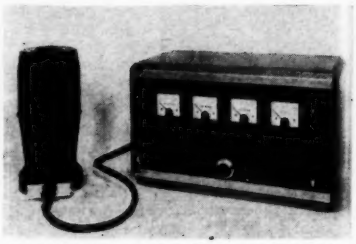
The magnet used is a standard Newport 7 in. electromagnet, Type E, with adjustable gap. Special 7 in. diameter poles and pole tips are fitted. The alignment is adjustable.

The power unit supplying the magnet is a new addition to the Newport range, and is designed to achieve high stabilities even under adverse conditions of mains supply fluctuations, and to achieve very low values of field ripple.

Nuclear Enterprises (G.B.) Ltd. **Stand No. 61**

Among the new scintillators to be shown will be the NE150 plastic scintillator developed by Nuclear Enterprises in collaboration with Mr. F. D. Brooks of Harwell for use with pulse shape discrimination techniques—particularly for counting fast neutrons in the presence of large gamma ray fluxes. Also on display will be specimens of the new wide range of crystal-photomultiplier assemblies where high quality inorganic scintillation crystals such as NaI(Tl), LiI(Eu) and CsI(Tl) are combined with specially selected E.M.I. photomultipliers to give improved gamma ray resolutions. The new design techniques applied to the assemblies have eliminated optical and light-tight problems, and special mounts can be supplied for very low level counting.

On the instrument side the NE8102B human body radiation monitor, which has been designed for a U.K.A.E.A. establishment in Scotland, gives high counting efficiency in an arrangement where the



Radio-iodine monitor (Nuclear Enterprises)

count rate is independent of localisation. An additional crystal gives localisation by means of a collimator. Four 5 in. dia. × 4 in. deep NaI(Tl) and one 3 in. dia. × 5 in. deep NaI(Tl) crystals are used in the detector heads which are capable of both horizontal and vertical movement.

The NE8421 radio-iodine environmental monitor is fully transportable and has a head unit consisting of a transistorised preamplifier and NE5502 lead castle with 2 in. photomultiplier and 1½ in. × 1 in. sodium iodide crystal. The control unit is similar in design to the Nuclear Enterprises Mark XII scintillometer with three channels arranged to cover the range of the main I^{131} gamma photopeak and to produce a difference count which is a sensitive function of the amount of I^{131} even in the presence of strong competing gamma radiation from other iodine activities. A second monitor—the air impactor unit—will be on display. It detects the presence of plutonium and other radioactive dust particles in the atmosphere using a continuously moving film coated with scintillation material coupled to a counting assembly.

An improved form of the non-overloading linear pulse amplifier NE5202 with gain of 50,000, and 6 microsecond recovery for 200 times the overload, will be exhibited together with a "broad gate" (20 volt) differential pulse height selector NE5102 and the improved liquid scintillation spectrometer NE8301, which gives efficiencies of 90% for carbon 14, 35% for hydrogen and 15% for iron 55.

The new NE5551 transistorised head unit for counting and analysis of neutrons and gamma rays, employs the Brooks principle of pulse shape discrimination in a photomultiplier-scintillator combination.

Of interest to industries facing problems of moisture control, the NE8401 transistorised moisture and density gauge has been developed for accurate *in situ* measurements of the moisture content and density of a large variety of materials under field conditions. The instrument is completely transportable and uses radium-beryllium (Type RAN5) and caesium 137 sources.

L. Oertling Ltd. **Stand No. 109**

The quartz fibre decimicrobalance, Model Q.01, will be on show. The beam is constructed of fine quartz fibres suspended by a torsion filament system. The load capacity is 250 mg in each pan and the torsion head range is 1 mg. Sensitivity is 0·1 microgram per division and the standard deviation is 0·08 micrograms.

A semi-automatic balance has been designed to weigh loads of up to 2 kg to an

accuracy of 0·1 g, and uses a system of mechanical amplification of the pointer movement to provide a large easily read scale covering 0-10 gram in 100 divisions, each division being approximately 0·05 in. wide.

Additions to the range of one pan instruments available include balances with vernier reading to enable weighings to 0·1 mg to be carried out much more rapidly.

The new models incorporate features which include full weight loading up to the capacity of the instrument, delta form light alloy beam, total enclosure of the beam and all parts, and grouped controls and reading for ease of operation.

Two new models of two pan balances have been added to the range.

These instruments have been designed with the co-operation of industry for rapid routine determination of moisture content in materials such as tobacco. The instruments have design features such as separate beam compartment, chassis construction, and detachable pans with a single support, giving very easy access.

A new series of adjustable analytical weights, in non-magnetic stainless steel, have also been developed.

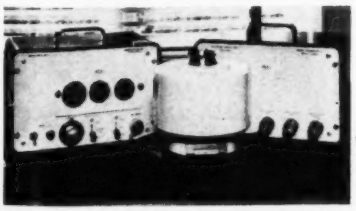
W. Ottway & Co. Ltd. Stand No. 91

The indicating or recording autocollimator measures the rotation of a mirror about horizontal and vertical axes. The instrument consists of two main parts, the collimator and the electronic control unit. Three ranges of readings are provided, 0 to ± 2 seconds, 0 to ± 20 seconds, and 0 to $\pm 2\frac{1}{2}$ minutes with sensitivities of $\frac{1}{10}$ second, 1 second and 10 seconds respectively. Visual readings are taken on a galvanometer which is suitably calibrated. Recording may be effected by introducing an amplifier and pen recording unit into the system. The circuit is designed primarily for an open loop system but may be converted to a closed loop with the addition of a servo system.

The "Opticano" is a simple type of optical bench designed for use by students and for laboratory assimilation work. The main feature of the design is the constructional aspect which enables various optical instruments to be built, for example, the telescope, microscope, collimator projector, binocular systems and similar.

Panax Equipment Ltd. Stand No. 81

A high sensitivity scintillation flow counter has been designed to monitor continuously the level of beta activity in liquids. It uses a specially designed flow cell constructed of a plastic scintillator of high efficiency which is housed in a standard well counter assembly. The complete counter is arranged in a universal lead castle, Type LC-4. The performance of the counter is such that 300 $\mu\mu$c/litre of strontium 90 can be detected with a background count rate of 1·5-2 counts/sec.



High sensitivity low background Geiger counting equipment (Panax Equipment)

A high sensitivity low background Geiger counting equipment comprises a lead castle designed to house a small mica window beta counter arranged inside a guard counter with provision for the use of standard one inch diameter planchets and absorbers or alternatively strips of paper chromatograms, an anticoincidence unit, Type AU/460, which incorporates a fully stabilised e.h.t. supply for the guard counter, and a compact two decade scaler, Type SA102, which has a variable and fully stabilised e.h.t. supply for the thin mica window counter.

This apparatus is particularly useful for the measurement of very low activity samples. Typical background count rates are of the order of 1·5 counts per minute. Counting equipment for use with Geiger counters, automatic counting equipment, a high efficiency tritium counter and a compact radiation level switch will be among other pieces of equipment to be shown.

Perkin-Elmer Ltd. Stand No. 49

The Model 137UV spectrophotometer has been designed as a high performance, low-cost, double-beam recording instrument for use in the ultraviolet and visible regions of the spectrum. Spectra are recorded on a linear absorbance/linear wavelength basis over the range 190-750 mμ, with automatic changeover of the hydrogen and tungsten lamps between the ultraviolet and visible regions.

Particular attention has been paid to attaining good photometric accuracy and reproducibility together with low values of stray light. High resolution has also been achieved at low noise levels, e.g., 0·2 mμ at 250 mμ with a noise level of less than $\frac{1}{2}$%. The scanning time is normally 2 minutes in each region, but a slower time of 8 minutes is provided for scanning of particularly sharp absorption bands. The sampling compartment is particularly spacious and easily accessible and a wide range of accessories will be available.

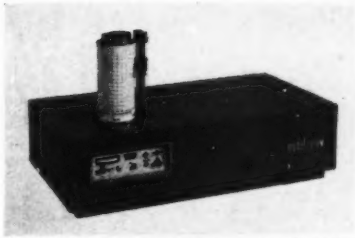
The Perkin-Elmer Fractometer incorporates the latest advances in gas chromatography in a fully modular design so that the most efficient combination of sampling device, column and detector can be chosen for each individual problem.

Four different detectors are available: thermistor, hot wire, β-ionisation and flame ionisation types. A novel feature is the possible use of two detectors together, a conductivity and an ionisation type respectively, so that special sensitivity requirements can be met.

Standard packed columns are available in special designs which allow measurements to be made at very low or very high temperatures. By these means, column temperatures may be varied between -75 and $+325$°C. Golay capillary columns with their high efficiencies of over 100,000 theoretical plates are also available, and can be used alone or in parallel with a packed column.

G. V. Planer Ltd. Stand No. 17

Hysteresis loop test gear has been designed for the display on a cathode-ray oscilloscope of hysteresis loops, and the determination of coercivity and remanence, of magnetic materials. The instrument has been developed for the testing of magnetic coatings and in particular of magnetic recording tape; it is also suitable for evaluating magnetic alloys, etc., in thin film, strip or wire form.



Model 137 UV spectrophotometer (Perkin-Elmer)

The equipment comprises a calibrated low noise amplifier and three alternative measuring heads with their corresponding power supply units to cover the ranges: 50 to 2,000 oersted, 0 to 150 oersted, and 0 to 10 oersted.

A machine will be shown for the automatic resin casting under vacuum conditions of electronic components or assemblies.

The equipment comprises automatic sequence control as well as vacuum and pressure regulation. Pneumatic rams are used for the movement of the vacuum bell jar and the control of resin flow. The duration of a complete resin filling cycle with vacuum/pressure application is approx. 1 minute, the vacuum being of the order of 100 microns.

A new method of displaying the timing, time duration and amplitude of electric pulses by the use of a delay line associated with a multi-element electroluminescent panel will be exhibited. Pulses, which may be as short as 5 millimicroseconds, are directed towards each other from opposing ends of the delay line; the increased voltage arising at the points of coincidence of the oppositely travelling waves causes excitation of the associated discrete zones of the phosphor panel.

The system has interesting potential uses in pulse work, etc., in replacing oscilloscope displays in certain applications.

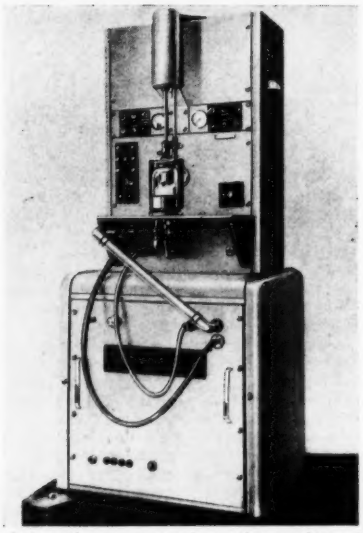
Magnetic film memory stores in toroidal and flat plate configuration will be exhibited. The elements consist of thin magnetic alloy films on glass base produced both by electrolytic co-deposition and by vacuum evaporation in a magnetic aligning field.

Switching time measurements in either type of element extend to as low as 2 millimicroseconds, the output ranging up to 4 V amplitude.

A millimicrosecond pulse generator has been designed primarily for switching time determination in memory stores, e.g., of the thin alloy film type.

The pulse range covered extends from 2 to 200 millimicroseconds, the output being suitable to drive switching elements requiring currents of up to 13 amp. The output voltage can be varied from 1,000 volts to below 1 volt.

The test specimen is mounted in a plug-in transmission measuring head with a



Automatic vacuum resin-casting equipment (G. V. Planer)

suitable pick-up loop. The generator is designed to be operated with positive or negative outputs at a pulse repetition frequency of 50 cycles, or with positive and negative outputs in varying ratios to enable switching or non-switching to be observed simultaneously. Suitable oscilloscope points and a synchronising output pulse are provided. The equipment is operated from 230 volts, 50 c/s.

The generator can be used in conjunction either with a high speed or laboratory type oscilloscope.

A miniature continuous track potentiometer with high linearity utilising a stannic oxide type resistance element on glass base will be shown.

The effective oxide track is $\frac{1}{10}$ in. swept length × $\frac{1}{32}$ in. width. The linearity is of the order of 0·1% and the rotational noise value below 0·05 mV/V at 12 volts d.c. over a test of 100,000 sweeps. The operating temperature range is −40 to +85°C.

A continuous response mercury levelling switch which comprises two integral oxide film tracks adherently deposited in the interior of a filled glass envelope will be on view. The tracks are bridged by a drop of mercury which is free to move longitudinally. The device provides an output varying with the angle of tilt in accordance with any desired law, the output being normally in the form of a current difference in a pair of identical load coils.

The switch is made in two types, viz., the law being determined by (a) the envelope shape or (b) the track configuration. The degree of damping can be adjusted to requirement.

High value resistors produced by winding of an oxide coated glass fibre of 0·8 mil diameter over a ceramic former and inductors utilising copper or gold-clad copper coil patterns directly adherent to borosilicate glass base will also be shown.

Plessey Co. Ltd. **Stand No. 35**

There will be ten demonstrations of silicon rectifiers.

Types of silicon rectifiers whose salient properties will be illustrated by means of demonstration include glass encapsulated subminiature types being used as power rectifiers, general purpose diodes, and fast switching diodes. Other types to be demonstrated are high voltage units for use in television h.t. supply circuits, subminiature types for use in ambient temperatures of up to +200°C and a range of silicon power rectifiers with ratings of 3, 10 and 30 amp with reverse voltage working capabilities of up to 500 volts and maximum working temperatures of up to +150°C.

A transistorised electrometer will also be demonstrated, its application will include measurements from pH electrodes and ionisation chambers.

Ketay Ltd. will be showing a number of electro-mechanical exhibits including a pendulum potentiometer, an analogue digital shaft encoder and a miniature servo system using size 08 servo components.

Plessey will be demonstrating circuit applications of tunnel diodes and Boff diodes, and new miniature aluminium electrolytic capacitors.

Among exhibits from the Components Group will be two transformers designed to function at temperatures up to 500°C. These transformers are the result of work carried out for the Royal Radar Establishment.

Magnets of many shapes and sizes made by **Preformations Ltd.** will be displayed with special emphasis on magnets for microwave applications such as high-power isolators.

A new 99-channel pulse height analyser designed by A.E.R.E. Harwell and manufactured by Plessey Nucleonics Ltd. under licence from the U.K.A.E.A. will be shown. This versatile equipment can be used with suitable accessories as either a pulse amplitude analyser or as a time-of-flight spectrometer.

Two dielectric test sets now nearing completion will also be exhibited.

Post Office Engineering Department **Stand No. 137**

In the measurement of gas evolution and in-leakage of experimental transistors an omegatron is used to distinguish between the in-leakage of a test gas and any out-gassing from the walls of the enclosure and the piece parts. Leak rates of 10^{-11} litre-microns per second can be detected and a mass resolution of 1 in 40 achieved. A miniature ionisation gauge will also be shown which has been mounted in an experimental transistor encapsulation; it enables the total pressure in an evacuated device to be monitored for several thousand hours.

The group delay/frequency distortion of microwave radio systems using frequency modulation must be closely controlled to reduce intermodulation noise. To measure group delay the Nyquist method is used and a test signal is frequency modulated with 1 Mc/s at a low modulation index and passed through the equipment to be tested.

A porous layer of magnesium oxide may be used as a cold source of electrons in a vacuum device. The electron emission (which is accompanied by a blue luminescence) depends upon the maintenance of a positive electrostatic field through the oxide layer. The behaviour of such cathodes has been examined under various experimental conditions, with particular reference to voltage and temperature effects, and to the influence of the residual atmosphere inside the valve envelope.

Experimental diodes will be used in an exhibit to demonstrate some of these effects.

To demonstrate a rotating disc magnetometer for the detection of magnetic anisotropy, curves displaying magnetic anisotropy will be shown on an oscilloscope by picking up the stray flux from a disk of material when it is rotated rapidly in a magnetic field.

According to the orientation of the coils, the curves may be similar to torque curves or may show the variation of permeability with direction.

In the study of speech there are many calls for a spectrographic representation produced in real time, i.e., for a process in which a spectral pattern unfolds in step with the spoken words; such a continuous real-time spectrograph will be demonstrated. Analysis is performed by a single filter which scans a rapidly repeated version of the immediate past of the signal.

A technique for studying plastic flow, with special reference to contact deformation was devised originally for investigating contact deformation. This technique can be applied to a wide range of related problems such as those encountered in studying processes of forming and extrusion. Effects of friction and rate of deformation, and of shape and internal constraint, can readily be examined. Two-colour laminated test bodies are made from "Plasticine"; the laminations can be oriented in any direction.

The **National Physical Laboratory and Post Office Engineering Department** are presenting a joint exhibit of standard frequency and time-interval signals. These signals are broadcast from Rugby Radio Station continuously on the m.s.f. carrier frequencies of 2·5, 5 and 10 Mc/s. M.S.F. 60 kc/s is also broadcast for one hour each day and all the m.s.f. frequencies are modulated with 1 c/s pulses for 35 minutes in each hour. In addition the carrier frequency of the GBR16 kc/s high power transmitter is controlled by the m.s.f. standard.

All these transmissions are related by frequency and by time-interval comparisons to a caesium standard of frequency at the N.P.L. The seconds pulses not only mark accurate intervals of time in relation to caesium but they are maintained within prescribed limits of the time scale U.T.2 as determined at the Royal Greenwich Observatory.

Demonstrations will show some of the techniques used for frequency comparison by phase recording on l.f. and v.l.f. transmissions and by measurement of reception times of m.s.f. seconds pulses.

W. R. Prior & Co. Ltd. **Stand No. 97**

A self-contained cinemicroscope for recording by continuous or by time lapse cinephotography movement or growth in any type of microscopical specimen will be

shown. It is designed primarily for studies of living cells in controlled environments, and provision is made for accurate control of the temperature of the specimen. Micromanipulators, metallurgical microscopes, inverted microscopes for applications in cell biology and stereoscopic, petrological and laboratory microscopes will also be shown.

R. B. Pullin & Co. Ltd. and Measuring Instruments (Pullin) Ltd. Stand No. 9

The following products will be shown by the two companies:

A torsional vibration tester, manufactured under licence from the National Research & Development Corporation, is for investigating and measuring the torsional vibration in components of rotating machinery such as the crankshafts of diesel engines.

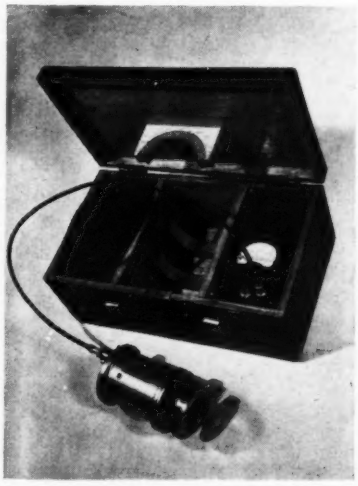
It consists of a generator type pick-up which when driven by the component under test produces an a.c. output signal proportional to the frequency and amplitude of superimposed torsional vibration. The signal is fed to a calibrated indicating instrument via a filter network having an output proportional to the amplitude of the vibration and independent of the frequency over a wide range of generator pick up speed.

The complete instrument is housed in a portable carrying case and requires no power supply for its operation.

New servo-components include a size 11 motor-generator available with an in-line gear-head, a size 15 servo motor with an associated size 10 tachometer generator and a range of size 11 synchros capable of continuous operation in ambient temperatures of $+110°C$.

A servo indicator designed to provide accurate remote position indication from the signal provided by a size 11 synchro, will be shown.

An on/off controller which makes use of a conventional moving coil instrument movement, has a flag at the pointer tip to interrupt a light beam directed on to a photo-transistor. The output of the transistor operates a relay connected into the circuit to be controlled.



Torsional vibration tester (R. B. Pullin)

Three alternative versions of the controller are available with a control point at approximately full-scale deflection for upward sensing application, at 5% of full-scale reading for downward sensing applications or with the two control points for dual operation.

A portable industrial thermometer has been designed to give a rapid and accurate reading of any surface, liquid or gas temperature using a small easily handled probe connected to an indicating instrument incorporating its own battery power supply.

Two alternative temperature calibrations are available, either $+10$ to $+110°C$ or -40 to $+10°C$.

W. G. Pye & Co. Ltd. Stand No. 100

The Pye Argon chromatograph range of instruments will be shown together with a wide range of accessories and adaptors and a variety of injection systems and long columns.

A model of the Pye process analyser will be shown. The process analyser can incorporate any of a range of specialised detectors available for special applications, and can easily be adapted to include column switching, sample selection and the back-purging of unwanted components. Besides the robust and dependable detection system, the equipment incorporates the automatic sampling valve designed and patented by I.C.I. Billingham Division. This enables small samples to be injected with an accuracy and reproducibility hitherto considered impossible.

Industrial pH amplifier "D" utilises a circuit which is essentially a carrier type d.c. amplifier employing a capacitor modulator, carrier amplifier and a phase sensitive demodulator with a high degree of overall negative feedback.

It provides complete automatic temperature compensation over the range 0 to 100°C and the standard instrument covers measurements between 2 and 12 pH.

Immersion type pH electrode assembly, a fully sealed pH electrode unit for use in open tanks, channels or troughs, and particularly designed to give the easiest possible maintenance, will be shown.

Other exhibits will include an industrial flow type pH assembly, the "Dynacap" pH meter and millivoltmeter, the autotitrator-controller, a rotary burette, a.c. bridge amplifiers and power unit, linear displacement transducers, stabilised power supply unit, a d.c. amplifier (contact modulator), a precision decade potentiometer and a galvanometer pre-amplifier.

Racal Instruments Ltd. Stand No. 16

The SA.505 digital frequency meter combines the latest transistor techniques in a compact, self-contained instrument and is suited to all laboratory applications in the fields of frequency, period and time interval measurement.

A seven-digit in-line projection display is incorporated which is arranged to display continuously.

The accuracy of frequency measurement is ± 1 count $+$ the stability of the internal crystal which is 1 part in 10^7, provision is made for operation from an external frequency standard of 100 kc/s or 1 Mc/s.

Digital outputs are available from the instrument in the form of relay contact closures enabling a remote readout to be operated directly or alternatively a printed digital record may be obtained by employing the 10-way serialiser, Type SA.138, operating an Addo-X printing machine.

A 10-way serialiser, Type SA.138, has been designed for direct operation with Racal digital frequency meters to provide permanent digital records on a solenoid-operated printing machine.

Digital input information in the form of relay contact closures is serialised by 11-position stepping switch which selects and energises the appropriate print solenoid. Maximum printing rate is 60, 6 digit prints per minute using an Addo-X solenoid-operated printing machine.

The SA.501A computing counter controller is a unique, fully-transistorised universal counter timer utilising transistor and ferrite core techniques. The instrument incorporates a fully variable digital time-base and an in-line Nodistron display.

Facilities include frequency measurement up to 110 kc/s, with an accuracy of ± 1 count $\pm 0{\cdot}005\%$, time interval measurement up to 27·8 hours. The SA.501A may also be used for period measurement as a frequency divider and as a clock pulse source.

Voltage-to-frequency converter, Type SA.503 provides a simple means of converting a digital counter into a digital voltmeter, an analogue-to-digital converter and a digital integrator.

A built-in potentiometer enables voltages in the range 0·5 V, 5 V, 50 V and 500 V to be measured, and by using a special procedure an input impedance of greater than 5 MΩ can be achieved on the 0·5 V range. The linearity is $\pm 0{\cdot}1\%$ of f.s.d. and the overall accuracy is $\pm 0{\cdot}25\%$.

Designed essentially as an industrial electronic tachometer the digital frequency meter, Type SA.502, is fully transistorised, incorporating in-line Nodistron readout and fully variable digital time-base. The instrument is battery operated and housed in a portable bench mounting cabinet.

A fully variable time-base enables speed measurements to be indicated directly in revolutions per minute or as a percentage of the maximum. The frequency range is 0-50 kc/s and accuracy of measurement is ± 1 count $\pm 0{\cdot}005\%$. All circuitry is arranged on printed circuit plug-in boards and the front panel controls have been minimised for simplicity in operation.

The SA.151 digital frequency meter is capable of measuring and displaying directly frequencies in the range 10 c/s to 155 Mc/s.

Various types of transducers will be shown in a working exhibit on shaft speed measurement.

An analogue tachometer, Type SA.507, may be used to provide direct shaft speed measurement up to 30,000 r.p.m. with an accuracy of $\pm 2\%$.

Royal College of Surgeons of England Stand No. 145

A gas chromatograph designed for the routine analysis of the gas and vapour mixtures encountered during anaesthesia will be shown. Samples of the gas mixture

to be analysed are automatically injected into the chromatograph at regular intervals by means of an electro-mechanical sampling valve. The detector unit is either a thermal conductivity cell or an ionisation cross-section detector. Two columns are employed, one to separate the gases, the other to separate the volatile anaesthetic agents.

A servo-operated pump which is a piston and cylinder pump having controllable characteristics has been designed to simulate a patient's breathing. It is intended to function as a test-bed, in conjunction with suitable recording apparatus, for the calibration of volume recorders and the measurement of resistance to breathing of apparatus.

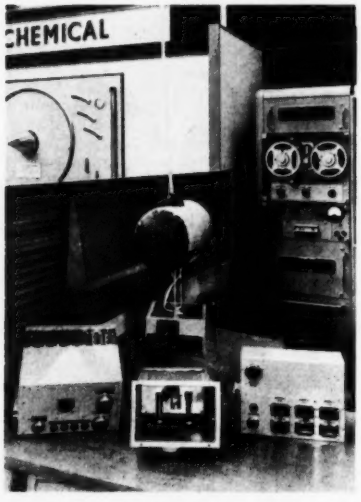
A minute volume recorder has been developed in conjunction with British Oxygen Gases Ltd. to record the level of respiratory exchange (in litres per minute). The output of a gas meter of conventional design is differentiated with respect to time. The differentiating device consists of a threaded rod rotated by the gas meter, and a cone driven at constant speed. A wheel is free to rotate on the rod, its rim making contact with the surface of the cone. This wheel takes up a position proportional to the minute volume of respiration.

Royston Instruments Ltd. Stand No. 34

Examples are shown of the Midas range of recording, playback, processing and tape transcription equipment. This year the emphasis is on the aircraft applications of Midas and the CMM range of cassette loaded recorders and associated processing equipment, which offer a complete system of economy and safety in civil and military flying.

With the CMM playback and processing equipment all data of routine significance can be produced in precis form as an automatically typed sheet—in one hundredth of the recording time—showing details such as GMT, Aircraft No., Data, Date, Flight No., Stage No. and also all operating parameters and abnormalities, such as over-levels, at the precise time at which these occur in flight. In addition, a list of computed factors is given for the complete flight. For special detailed studies, data can be presented on pen records, XY plots, or digitalised and presented as typed records, or on punched cards or tape for processing by computers.

The Midas tape transcriber has been developed to permit the direct interchange of tape between the British Standard Midas system and American Standard system. It consists basically of four tape spools, one recording and one replay head, a single capstan and two pinch wheels, together with associated plug-in electronic modules. British type heads are provided for one tape and American type heads for the other.



"Electable" unit, electronics and time multiplexing switch (Royston Instruments)

Sangamo Weston Ltd. Stand No. 114

Three new developments which will be shown by the company will be:

1. A digital indicator Model S.462 which is basically a moving coil instrument carrying a scale past an optical system such that a bright numeral is projected on to a frosted screen.
2. Model S.133 Form 6 servo-potentiometer which has a 20 mV output for a 1 mV input. The load can be up to 1,000 ohms.
3. A thermocouple system for aircraft engines of the by-pass turbo-jet type to measure and limit flame temperature of such engines, known as the Autocomp system.

Science Museum Stand No. 143

A reconstruction of the Boyle-Hooke vacuum pump of 1659 will be shown.

A cosmic-ray telescope which consists of a simple Geiger-counter assembly to show that the mu-mesons and electrons present in cosmic rays at the earth's surface are moving mainly in directions near the vertical will be shown. Two groups each of four counter tubes are mounted in an assembly which can be rotated about a horizontal axis. Each group is connected through a pre-amplifier, to a coincidence unit which responds only when an ionising particle passes simultaneously through both groups of counters. It is noticeable that the number of audible counts per minute is much greater when one group of counters is above the other than when they are side by side.

The coincidence unit is by Dynatron Limited, the probe units are by Ekco Electronics Limited, and the counter tubes by 20th Century Electronics Limited.

Servomex Controls Ltd. Stand No. 11

Among the equipment to be exhibited will be a breathing simulator for testing anaesthetic equipment and breathing apparatus.

The machine can be operated at varying speeds as it incorporates a Servomex MC 47 motor controller system, which also provides for rapid acceleration during each simulated breathing cycle.

The machine thus acts as a "mechanical patient", which simulates a wide variety of breathing patterns. It has been developed for experimental use in testing anaesthetic equipment and breathing apparatus generally (including, for instance, that used by aircrew).

Oscillograph recording camera (D. Shackman)

D. Shackman & Sons Stand No. 7

A 70 mm film camera for instrument, document and oscilloscope recording will be on view. The camera may be operated automatically for shot-by-shot recording requiring only a single electrical impulse of 24 V to operate the focal plane shutter and transport the film ready for the next exposure. For continuously moving film photographs, the film speed is infinitely variable between 40 inches per second and 1 inch per second.

The Autocamera Mark 3 and its accessories will also be shown. The instrument may be used where the rapid production of high quality 35 mm microfilms is required.

A range of oscillograph recording cameras will also be shown.

Solartron Electronic Group Stand No. 111

Among the new instruments to be shown will be the mark-space height multiplier, Type TR1022, a mark-space generator sub-unit provides a ±10 V modulated square wave output sufficient to drive up to five height modulator sub-units, these latter units completing the required multiplication; a true r.m.s. voltmeter, Type JM1067, which will accept input frequencies between 0·1 c/s and 10 kc/s with four switched smoothing time-constants available; a resistor digital test set, Type EM1006; and a miniature 12 Mc/s oscilloscope, Type CD1015.

An exhibit of digital computer components will show logical element packages intended for the construction of digital computers and other digital devices operating with a 1 megacycle clock frequency.

The LP 1043 translator which will be shown is designed to work in conjunction with the LP942 analogue-digital converter. It takes a binary coded decimal input, in which each decade is represented by four inputs having the significance eight, four, two, one, and translates it into decimal form. The output is displayed as a five window digital display, and is available at an output socket to work a high-speed printer.

Solus-Schall Ltd. Stand No. 126

Solus-Schall Ltd. will be showing the following apparatus for crystal analysis research:

A generator for crystallography which will supply a fully rectified completely

smoothed precisely stabilised voltage and current to energise one sealed off water-cooled earthed anode X-ray diffraction tube between 15 and 60 kilovolts at 60 milliamperes. An associated work table section is designed to support one or two X-ray diffraction tubes, diffractometers, cameras and the electronic instruments required for counter detector techniques.

X-ray diffractometer, No. 50200, may be used for determining the position, intensity, and width of diffraction lines from poly-crystals or from single crystals in the plane of motion of the counter tube.

Electronic fast counting ratemeter/amplifier, No. 50211, for X-ray diffractometry employing Geiger, proportional and scintillation detectors, incorporating a stabilised e.h.t. supply, variable gain control, discriminator, cathode follower output circuit for a scaler, recorder, etc., and ratemeter ranges from 0 to 100,000 pulses per second.

A dekatron gated counter scaling unit designed primarily for use with diffractometers and ratemeter/amplifiers.

An inching device for the angular degree per minute control of a diffractometer.

A chart recorder with fast response milliammeter movements, using a continuous line ink pen on synchronous motor-operated charts, for tracing diffraction intensities obtained by counter techniques in conjunction with ratemeter/amplifiers.

General accessories for crystal analysis research will also be displayed.

Standard Telephones & Cables Ltd. Stand No. 112

An artificial mouth has been produced for the measurement of the frequency characteristics of telephone transmitters. The dimensions of the orifice and the surround have been chosen so that the sound field in the region within 5 cm of the orifice is a close approximation to that round a human mouth.

An electronic spectroanalyser will be shown. Absorption spectra obtained by a spectrophotometer are punched as binary numbers on paper tape via an optical converter which transforms a shaft rotation, corresponding to percentage transmission, into a signal representing $\log_{10}$ (absorbence). Tapes are prepared for mixture and individual component spectra and run through a twin tape reader in pairs. The absorbence values at each successive wavelength are multiplied together and all the products summed. Multiplication and integration are performed by a transistorised digital computer giving numerical values as a light display.

These values are inserted into modified simultaneous equations which are solved manually or by another computer; concentration values are obtained in terms of the known concentrations of the component spectra used in the computations.

The technique has been largely applied to infra-red spectra, but is now being used for u.v. and visible spectra at Standard Telecommunication Laboratories.

A pair of coupled pendulums with movable pivots can be used to give an exact representation of the action of a Mavar low-noise amplifier. A solenoid provides the signal input, eddy current damping provides the load, the pendulums represent the tuned circuits at the signal and "idler" frequencies and the vertical movement of the pivots at the sum frequency represents the "pump" supply. The model is capable of demonstrating stable and unstable oscillation.

An exhibit will demonstrate the use of infra-red optical filters in detecting the presence of carbon dioxide in the human breath.

The apparatus has applications wherever a need for the quick and continuous detection of carbon dioxide exists. Such a need exists in the physiological study of respiration, in the industrial requirements of greater combustion efficiency, and in the meteorological interest in carbon dioxide concentration.

Examples of wider applications using this principle are investigations into anaesthetic gases, process control in the petrol and petrochemical industries, detection of leaks, ventilation problems by tracer techniques and the analysis of organic compounds and reaction rates.

A carrier telephone system has been designed to transmit up to 300 speech circuits over a pair of small diameter coaxial tubes, using the frequency band of 60-1,300 kc/s. The tubes have an internal diameter of only 0·163 inch.

Exhibited on the STC stand is a dependent repeater. These repeaters use transistors throughout and are buried in the ground at intervals of 12,000 ft; they each provide a gain of about 27 dB at 1,300 kc/s. Alternate amplifiers are normally equipped for pilot-frequency-controlled automatic gain regulation.

Power to operate these dependent repeaters is fed over the coaxial tubes from the nearest main repeater or terminal station on a constant current d.c. series basis.

Other equipment to be shown will include a 7,000 Mc/s portable outside broadcast link for television, two new backward wave oscillators covering the range 18 to 40 Gc/s, coaxial tube and H wave oscillators, travelling wave tubes, switching transistors, Mesa transistors, tunnel diodes, a frequency source and crystal filters, transmission testing equipment, and a range of capacitors.

Sunbury Glass Works Ltd. Stand No. 88

The company will be exhibiting glass targets which represent samples of thin glass and quartz crystals ground and polished for use in one case for Electric & Musical Industries Ltd. as part of the C.P.S. camera tube and the other for use by U.K.A.E.A. These targets vary in thickness from 0·0008 in. to 0·0035 in.

Many different types and sizes of attenuator vanes in glass and ferrite will be shown, some being not thicker than 0·004 in.

Among the quartz silica exhibits will be samples of holes of 0·036 in. diameter, drilled to precision.

A further quartz silica with a square hole in the centre and various other holes drilled to precision has been supplied to the United Kingdom Atomic Energy Authority.

Taylor, Taylor & Hobson Stand No. 122

The prototype of a new development that enables the surface finish of a 1 mm diameter ball to be measured and recorded accurately, in half millionths of an inch, will be shown.

Surface measurement of a 1 mm ball (Taylor, Taylor & Hobson)

It is the small ball surface measuring attachment for use with the Talysurf Model 3 surface measuring instrument.

The attachment consists of a stationary pick up unit in which a stylus is mounted underneath a conical seating. The ball to be tested is placed in the seating where it is then rotated by a friction drive, controlled from the standard Talysurf gearbox. The ball is given the same surface velocity as is normally applied to the traverse of the Talysurf pick-up in its conventional form. This permits both graphs and average readings to be obtained from a standard Talysurf 3.

The range of balls catered for is 1 mm to 1 inch. Graph readings are recorded with magnifications up to × 50,000 ($\frac{1}{10}$ inch on paper representing 0·000002 in.).

Another prototype on view will be the new Model 105 Talysurf, which will measure the surface finish inside cylinders of $\frac{1}{4}$ in. diameter to a depth of 10 in. It is a portable and relatively inexpensive instrument, suitable for a wide range of workshop and inspection applications. It provides centre line average readings with 0·03 in. cut off.

Two other new attachments for the Talysurf Model 3 will be included at the exhibition:

1. The cylindrical datum attachment for dealing with radii of from 2 in. to infinity by the supply of suitable glass cylinders. This accessory is complementary to the existing radii attachment and deals with the surface finish on both convex and concave radii.

2. A limit for adapting the side acting gauge head to the Talysurf 3 gear box gives a lower magnification range— × 100 to × 5,000.

Also on the Taylor, Taylor & Hobson stand will be the Varotal II television studio zoom lens and Varotal III television outside broadcast zoom lens, the Model II Talyrond, the Talyvel electronic level, 28 mm f/2 Ortal lens for image orthicon cameras and a range of Ental professional enlarging lenses.

Techne (Cambridge) Ltd. Stand No. 52

The Sentichart, an instrument designed to detect and record changes of temperature of as little as 0·01°C anywhere in the range from 30°C to 180°C on a circular chart, will be shown. The chart drive can be supplied to operate for 1 hour, 8 hours, or 72 hours, with a span of 0·40°C, but

less sensitive detecting can be fitted to extend this span. The temperature time curve is recorded in true polar co-ordinates.

A further development of the existing gelation timer has resulted in an instrument reciprocating with a shorter time cycle than the standard instrument. The user can establish more accurate timings on samples with shorter gelling times (less than the 20 minutes specified for the standard gelation timer).

A new model of the "Tempunit" thermostatic temperature controller will be exhibited. It operates over a wider range of temperature, and has booster heating in addition to the normal controlling heater.

The Techne printing viscometer measures and prints the viscosity of any liquid from 0·5 centi-poises upwards. It is a "dip type" viscometer of one inch diameter which can be lowered into any container. Operation of the instrument is extremely simple; it is completely transistorised and has its own crystal controlled timing circuit.

H. Tinsley & Co. Ltd. Stand No. 81

In the Tinsley photocell galvanometer amplifier, Type 5214, the amplified error voltage controls pulses which operate the potentiometer dials until a balance is secured to the least count of 10 μV. The residue is indicated on a precision drum recorder readable to 0·1 μV, this presentation being adopted to facilitate the measurement of varying e.m.f. (e.g., from thermocouples). When the recorder pen reaches either extremity the 10 μV dial is automatically moved up or down.

A digital read-out system is used for the dial positions: alternatively any form of coding may be used. The pulse rate is determined by the magnitude of the error voltage, the maximum being 200 pulses per minute.

A very high precision potentiometer, comprising two series-connected potentiometers, will also be shown.

Using cascaded galvanometer-amplifier stages with a transistor as the control element, a current of 15 mA can be stabilised to 1 part per million. Control is effected by referring the potential difference across a precision resistor carrying the current to a standard cell, the characteristics of which then determine the ultimate stability.

Controllers can be constructed to stabilise currents of 10 A to the same stability.

A standard cell battery will be shown with twelve cells each with its own pair of terminals housed in a thermally-shielded metal block. The temperature of the shield is maintained the same as that of the block by a novel ambient temperature monitor and corrector. The temperature of the cells is maintained within $\pm\frac{1}{200}$°C at a control temperature of 25°C.

The standard d.c. potentiometer to be shown has been designed in collaboration with the National Physical Laboratory.

It consists of three series-connected potentiometers each with two dials. The first dial is of 18 steps of 0·1 V, the remainder being decade dials. A seventh dial of 0·1 μV steps is the only vernier dial in the system.

Two galvanometers are built in to standardise the second and third potentiometers; an external galvanometer is used to adjust and monitor the standardisation of the first potentiometer against a standard cell. The standard cell dial is in steps of 1μV. No separate standardising circuits are used, the potentiometer coils themselves being used for the purpose.

An automatic hysteresis loop recorder which will facilitate the testing of ring specimens, a B-H loop being automatically plotted under controlled conditions of magnetisation in a few minutes, will be shown.

Developed to a basic design of C. A. Parsons & Co. Ltd., and the subject matter of their British Patent Application No. 15163/58, fast response Kelvin double bridge applies a larger initial voltage to the transformer winding under test, the voltage being automatically reduced to the relative value when the correct current is attained. By this means inconvenience and errors due to large inductive time-constants are offset.

An improved version of the Smith bridge No. 3, recognised throughout Europe as a standard laboratory instrument, will be shown with Barber type platinum resistance thermometers.

A sensitive amplifier and a computer galvanometer will also be shown.

The Tintometer Ltd. Stand No. 87

The company will be demonstrating the Lovibond Schofield Tintometer which is a visual colour measuring instrument for use with liquids, solids, powders or pastes using reflected or transmitted light.

This instrument enables readings made, using the Lovibond series of red, yellow and blue glasses, to be converted to the x, y, z, values of the C.I.E. system and part of the exhibit will show the work done by the late Dr. R. K. Schofield to enable this conversion to be made.

Thermal Syndicate Ltd. Stand No. 44

The company will be showing examples of various grades of "Spectrosil", synthetic fused silica.

Spectrosil A is recommended for general work in the ultra-violet region and for ultrasonic delay lines. Spectrosil B is a similar material but is manufactured against a strict specification for transmission characteristics, permissible refractive index variation and presence of bubbles.

Townson & Mercer Ltd. Stand No. 94

To meet the need for Warburg apparatus adapted to photosynthesis techniques and for use below ambient temperatures, Townson & Mercer Ltd. will be showing two developments of their standard circular low inertia Warburg apparatus, a photosynthesis model, and a refrigerated model.

Lovibond Schofield Tintometer (Tintometer)

The latest version of the company's rigid glove box or isotope handling cabinet incorporates an improved moulded window gasket which gives a cleaner line without loss of efficiency of the seal. The external appearance of the cabinet has also been improved by the use of suitable plastic mouldings along the edges. These boxes are normally fitted with exhaust pumps with Harwell type filters for radioactive work.

The latest form of their flexible handling cabinet has been evolved by the use of improved welding techniques. The cabinet itself remains basically as hitherto, but a rigid frame is now available to support the cabinet internally.

The infra-red moisture tester has been improved by the incorporation of a more compact infra-red bulb which allows for the testing of bulkier samples than was possible with earlier models.

The Sortationer is an instrument for the electronic sorting of non-ferrous metals and alloys for various industries, and can now, by suitable adaptation, be used for the sorting of titanium.

The zero portable refrigerator unit is an inexpensive low-powered sealed unit for laboratory use. There is sufficient power to maintain a difference of 5 to 10°C between the ambient temperature of a reasonably-insulated thermostat bath up to seven gallons capacity.

A heated humidity cabinet, fabricated in fibreglass, with a plate glass door, which can have a heater incorporated to raise the temperature of the cabinet up to 40°C, has recently been developed by the company and will be on view.

Ultrasonoscope Co. (London) Ltd. and Glass Developments Ltd. Stand No. 82

The general purpose flaw detector, Mark II, is a new addition to the Ultrasonoscope range of ultrasonic flaw detectors and replaces the existing Mark IB portable instrument.

It has a very fast time-base speed and high trace brightness combine with a rectified or unrectified trace display to enable a comprehensive study of flaw echo shape. The operational frequency range of $\frac{1}{2}$-10 Mc/s and a maximum depth range of 20 ft (in steel) extend the possible application range over a very wide number of non-destructive inspection problems. A 5 in. diameter high definition cathode-ray tube reduces operator's viewing fatigue.

The miniature flaw detector, Mark III, has a full 5 in. display of fine definition and high brightness to reduce operator fatigue. It weighs only 28 lb and has single, double or combined double probe working.

A research immersion tank unit has vertical adjustment over a distance of 10 in., rotational adjustment about the vertical axis through 360°, and tilt adjustment about a horizontal axis from −10° to the vertical through 200°.

Provision is made so that the crystal face of the inspection probe may be aligned with the axis of rotation (tilt) after insertion in the manipulator.

The probe may also be aligned with respect to the specimen under inspection

by an adjustment which is independent of the sealed manipulator controls.

Glass Developments Ltd. are showing a permanently sealed ammonia maser frequency standard. This maser has been designed as a portable, rugged and completely sealed unit. The gas reservoir contains sufficient ammonia to operate the device for several days, after which the gas may be recirculated without the use of valves or special processing. The frequency stability of this oscillator is better than 1 part in 10^9 per day. Both the e.h.t. supply and the cavity temperature control units are fully transistorised. Electronic circuits for the reduction of the maser frequency will be demonstrated together with the above instrument.

Unicam Instruments Ltd. Stand No. 107

The company will be exhibiting two instruments, the SP.700 spectrophotometer and the new SP.200 infra red spectrophotometer.

The SP.200 is a simple and inexpensive double-beam instrument designed for routine analysis. A spring-loaded ballpoint pen is used to record spectra and the pen pressure is such that a carbon copy of the spectrum may be made together with the original. The electronics are arranged as 3 plug-in chassis units. The output from the detector is amplified as 10 c/s and synchronously rectified by means of a contactor operated by the beam switch. The output from the contactor is converted to a 50 c/s signal and used to drive the servo motor.

United Kingdom Atomic Energy Authority Stand No. 39

The Atomic Weapons Research Establishment is to display data handling equipment which has been developed to speed up assessment of film records, and to present the data obtained in a form suitable for direct input to a computer. The digitised film assessor to be shown has been developed from the original manually-read assessor, as manufactured by A.G.I. Ltd., so that the information obtained can be punched directly on to cards for computing. Films or plates are located in a carriage, the X and Y movements of which are digitised, and the picture is projected on to a screen with a magnification of 10 : 1. The carriage is positioned by motors controlled by manually-operated flywheels which, when spun, will drive the carriage at a high speed, or will provide a fine adjustment for positioning the picture under the cross lines.

The digitised microdensitometer to be seen will be a double beam MK3, as manufactured by Joyce, Loebl & Co. Ltd., mounted on a console which houses the ancillary digitising equipment and control panel. An adapted specimen table, which has been designed to reduce friction, has digitised X and Y movement. The density readings have also been digitised so that the pen output can still be used if required.

University of Reading Stand No. 144

The Department of Physics will be showing apparatus for focusing and aligning an electron or ion beam by remote-control. When a high energy electron or ion beam has to be focused and aligned to pass through a diaphragm, the radiation hazard makes it impossible to observe the position of the beam on a fluorescent screen. The exhibit shows how a remote observer can determine the position and focus of an electron or ion beam.

The Department of Chemistry will be showing a dust generator giving controlled dusty atmospheres for pneumoconiosis research.

W. Vinten Ltd. Stand No. 6

Various accessories have been introduced for the Mark I and Mark II 16 mm scientific cameras. They can now be used in conjunction with a specially designed control box combined with a 200/250 V a.c. transformer rectifier. An electromechanical intervalometer for automatic time lapse photography has been produced which covers a range from 2½ seconds to one hour.

Two types of 16 mm high speed camera will be exhibited, one version being capable of operation up to a maximum of 250 pictures per second.

A 35 mm instrumentation camera will also be shown. This camera is capable of a range of speeds from single shot to 48 pictures per second.

Venner Electronics Ltd. Stand No. 19

Venner Electronics Ltd. will be showing a range of new transistorised instruments. Apart from a comprehensive data logger for monitoring voltage, frequency, time and resistance, they are featuring their new digital volt ohm meter (DVOM). This fully transistorised, 4 digit instrument measures d.c. and a.c. voltages from 1 mV to 1·1 kV and resistance to 1·1 MΩ. The results are displayed by new type in-line projection indicators.

A further addition to the 1961 range is a 6 digit frequency meter, attractively styled in grey and blue, capable of measuring frequency to 1 Mc/s, and time in units of 1 μsec. The display is by new type in-line projection indicators.

For permanent recording Venner Electronics will be showing their reperforator control unit for 5-hole tape, and their high speed printer.

Venner Accumulators Ltd. will be showing their latest developments in a range of lightweight accumulators of the primary activated type.

W. Watson & Sons Ltd. Stand No. 101

W. Watson & Sons Ltd. will exhibit a new interference microscope objective for the examination of specimens by reflected light at a magnification of approximately ×100. The Lau-Sabattier photographic technique can be used to produce photographs showing fine lines representing contours of equal intensity on the original fringe pattern.

The Watson cystoscope, which is designed to allow a urologist the facility of rapid photography in colour for the recording of pathological conditions, will also be shown for the first time.

The Barnet ventilator which can be used to supply anaesthetic gases from standard theatre apparatus and also air or gases from pipe lines, cylinders, pumps, and compressors is also shown in its latest form.

A full range of microscopes for application in science and industry, complete with the latest accessories, will also be exhibited.

Wayne Kerr Laboratories Ltd. Stand No. 102

Among the new instruments to be shown will be a self-balancing bridge B141.

With a digital voltmeter and channel selector, the B141 can measure—with a discrimination of 0·05%—displacement, torque, strain, permittivity, vibration, temperature and pressure. A decade switch circuit is provided whereby the sensitivity can be increased and a presetting feature allows maximum and minimum reading limits to be set and an appropriate alarm system to be arranged.

The precision electrometer M141 to be shown has a maximum charge sensitivity of 3×10^{-15} coulomb, and can be used for capacitance measurements as low as 3 pF and for d.c. measurements of from 10^{-15} amp to 10^{-6} amp with a direct reading accuracy of 1%. By means of decade switches this accuracy can be increased to 0·1%. A built-in Weston cell allows each range to be individually calibrated and the use of an external capacitive potentiometer permits the voltage range to be extended to 1,000 volts.

The new grinding bridge B341 will be demonstrated with a Jones & Shipman tailstock providing continuous indication of dimensions during grinding and having facilities for automatic control.

Another Wayne Kerr instrument on show for the first time is a portable salinity bridge for measuring the salt content of water.

Other instruments to be displayed include a low inductance bridge, a universal bridge, a short duration pulse generator, a v.h.f. portable frequency standard, a level detector (to be demonstrated with a water tank) and a group of microwave instruments for the measurement of microwave power and wavelength.

Wray (Optical Works) Ltd. Stand No. 13

The Wray 6 in. f/4·5 wide angle survey lens which satisfies the need for a wide angle coverage without any sacrifice in quality or speed compared with normal angles will be shown. The lens is fitted as standard to the Ministry of Supply FX105 aerial survey camera.

A binocular magnifier will be shown that has been designed for the inspection and manufacture of very small assemblies. It gives magnification of 10× linear with a working clearance of 7 in. between the object glass and the focused image.

The Prismscope telescope has an interchangeable eyepiece of 20× and 30×. A unique system of focusing is incorporated in the instrument. In place of the rotating eyepiece, a rigid eyepiece is fitted and provision for focusing is provided by a moving platform, complete with prism, by a multithread screw acting through a waterproof gland.

Other exhibits include a 35 mm camera complete with range of lenses for oscillograph recording, a range of binoculars and lenses for industry and scientific purposes, and a prototype beam focusing camera for scientific and engineering photography.

This preview represents the latest information available at the time of going to press.

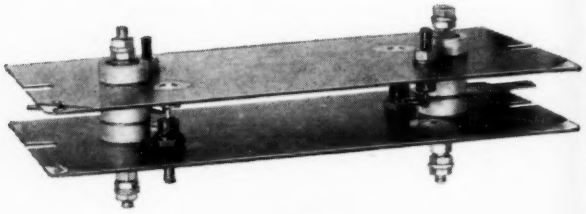
Circle **173** for further information

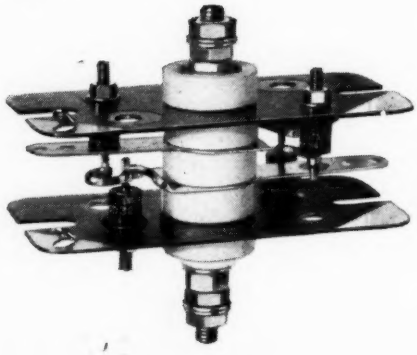
BRADLEY

BRIDGE RECTIFIERS

INCORPORATING LUCAS SILICON DIODES

A new range of silicon rectifiers, suitable for single-phase full-wave bridge operation. Available in 2A, 7A, 12·5A and 20A stacks, each with peak inverse voltage ratings of 50, 100, 200 and 400 volts.





Model No.	Dimensions (inches)	P.I.V.	Max. Input volts (R.M.S.)	IDC (Amps) at 25° C.	Max. Ambient Temp. °C.
IB320A	1½×3×2¾	50	35	2·0	150
IB321A	1½×3×2¾	100	70	2·0	150
IB323A	1½×3×2¾	200	140	2·0	150
IB326A	1½×3×2¾	400	280	2·0	150
IB320B	3 ×6×2¾	50	35	2·0	150
IB321B	3 ×6×2¾	100	70	2·0	150
IB323B	3 ×6×2¾	200	140	2·0	150
IB326B	3 ×6×2¾	400	280	2·0	150
IB510A	1½×3×2¾	50	35	10·0	100
IB511A	1½×3×2¾	100	70	10·0	100
IB513A	1½×3×2¾	200	140	10·0	100
IB516A	1½×3×2¾	400	280	10·0	100
IB510B	3 ×6×2¾	50	35	18·5	100
IB511B	3 ×6×2¾	100	70	18·5	100
IB513B	3 ×6×2¾	200	140	18·5	100
IB516B	3 ×6×2¾	400	280	18·5	100
IB510C	4 ×8×2¾	50	35	20·0	100
IB511C	4 ×8×2¾	100	70	20·0	100
IB513C	4 ×8×2¾	200	140	20·0	100
IB516C	4 ×8×2¾	400	280	20·0	100

LUCAS

GEB

Joseph Lucas Ltd

For further information and prices—apply to

G & E Bradley Ltd

SEMI-CONDUCTOR DIVISION. *Telephone* Gladstone 0012
ELECTRAL HOUSE, NEASDEN LANE, LONDON, N.W.10.

A Subsidiary Company of Joseph Lucas (Industries) Ltd.

NEWS OF THE INDUSTRY

INSTRUMENTS

SEMICONDUCTORS LIMITED have now been able to introduce further **price reductions for their transistors.**

The new reductions were introduced on 1st November and apply to almost all the company's range. In many cases they amount to about one third of the previous selling price. For example, the 2N501 micro alloy diffused base high-speed switching transistor, which costs 75s. 6d. each for quantities of one hundred up, now costs only 49s. 0d.

AN **IBM 7090 data processing system** has replaced the IBM 709 which has been in operation at the United Kingdom Atomic Energy Authority since July, 1959.

The 7090, which is a fully transistorised machine, is of an exactly similar specification to the 709 but will nevertheless be capable of operating from four to six times faster.

The 7090 was delivered to the U.K. A.E.A. on the 19th September, 1960, programme testing was completed by the 5th October and the machine was formally handed over on the 12th October, 1960.

The 7090 has a magnetic core storage holding 32,000 computer words of 36 bits each. All other data are stored on magnetic tape. A multiplexor unit controls the simultaneous input and output of data through four transmission channels while the processing unit is carrying out calculation.

THE Admiralty has ordered a computing system from Redifon Ltd. for use as a simulator in the design of naval control equipment and instrumentation. It will be installed at the Admiralty Experiment Works at Haslar, near Gosport, Hants.

The system is a new type of electronic computing and data handling equipment, called **RADIC (Redifon Analogue-Digital Computing System),** in which analogue and digital computing techniques are combined. First introduced in June, 1960, it is designed to be expandable rather than a fixed-size computer.

The versatility of the RADIC design is emphasised by the fact that the equipment will be linked directly with orthodox analogue computers already at Haslar, and also with actual instruments used in naval control systems.

Analogue computing elements in the equipment ordered include d.c. amplifiers, servo and electronic multipliers, and function generators. Digital elements include a digital read-out and scanning unit and an analogue-to-digital converter.

Price of a typical medium-sized installation with comparable facilities is approximately £20,000.

A germanium window, 15 inches diameter and ½ in. thick, has been produced by Hughes Aircraft Co. The purity of the germanium is one in ten billion. The window will be used in the infra-red sensors used in detection systems for missile guidance and space surveillance.

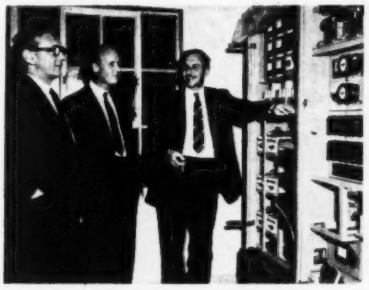
The 9½ lb of germanium used in casting the window is valued at £2,000. After the casting is taken from the mould it is optically ground and polished by a technique similar to that used for fine glass lenses, and is then ready for adaptation to an infra-red sensor.

COMPANIES

A LARGE American company has joined the Birfield Group of Companies as a result of the purchase by **Birfield Ltd.** of the **Bound Brook Oil-less Bearing Company,** of Bound Brook, New Jersey, U.S.A. The agreement provides for an outright purchase for an undisclosed sum and becomes effective on 1st January, 1961, when the American company will also change its name to Bound Brook Bearing Corporation of America.

The purchase of the American company has a particular historical interest for Birfield Ltd. because when the Birfield Group was formed in 1938, largely by an amalgamation of Hardy Spicer Ltd. and Laycock Engineering Ltd., a Hardy Spicer subsidiary company which automatically came into the Group was Bound Brook Bearings Ltd., who now have a large modern factory at Lichfield, Staffordshire. In 1938 the British Bound Brook Company was relatively small and was manufacturing graphited bearings under licence from the American Bound Brook Oil-less Bearing Company. With the growth of powder metallurgy techniques, sintered bronze and iron bearings impregnated with lubricating oil were added to the range, still under licence, and expansion of the British company was rapid until it has now become one of Great Britain's largest manufacturers of sintered bearings, filter elements and engineering parts.

The full circle has thus been completed with the acquisition by the Birfield Group of the original Bound Brook Oil-less Bearing Company of America. It also means that the Birfield Group becomes the world's largest manufacturer of sintered bearings and parts by virtue of wholly owned Bound Brook production plants in Lichfield, England, and in the U.S.A. at Bound Brook, New Jersey, and Sturgis, Michigan. Birfield Ltd. also has a considerable financial interest in Mahindra Sintered Products (Private) Ltd., of Bombay, India. Additionally, the Ugine-Carbone subsidiary of Société d'Electro-Chimie d'Électro-Metallurgie et des Acieries Electriques d'Ugine, of Paris, is licensed to manufacture Bound Brook products, and negotiations are currently taking place with companies in other parts of the world who also wish to manufacture under licence.



Part of the Ferranti Pegasus digital computer, shown immediately after its arrival at Bruce Peebles & Co. Ltd. recently. Inspecting part of the £60,000 computer are, from left to right: Prof. M. W. Humphrey-Davis, Queen Mary's College, London University; Mr. W. Sharpley, Chief of Research, Bruce Peebles, and Mr. D. Donald, Director and Chief Engineer, Bruce Peebles.

DELAPENA & SON LTD. have relinquished their agency for the products of Balzers Aktiengesellschaft für Hockvacuumtechnik & Dünne Schichten, Principality of Liechtenstein, who have now set up their own United Kingdom organisation as **Balzers High Vacuum Ltd.** with an office at 1 Mornington Terrace, London, N.W.1, formerly Delapena's London Office.

Delapena and Son Ltd. have been appointed sole agents, for Great Britain and certain other countries, for the range of induction heating handling equipment manufactured by the firm Fritz Düsseldorf, of Freiburg, W. Germany.

Fritz Düsseldorf have specialised in the design and manufacture of induction heating handling machines and fixtures for many years.

The range includes special-purpose and multi-purpose fixtures for heating parts under all production conditions. Models are available suitable for batch production, long runs and fully automatic production lines; for hand loading and manual control or for fully automatic cycle control. The fixtures are suitable for any of the processes usually associated with induction heating, but their greatest potential is in their application to selective hardening.

The new range does not include any generating equipment and Delapena &

Son Ltd. will continue to supply their own series of induction heaters (radio-frequency generators) and middle-frequency motor generators.

The arrangement will, however, enable Delapena's Projects Department to call on a much wider range of well-tried standard and semi-standard machines to suit many types of application, while allowing them to concentrate to a greater extent on the design and manufacture of special-purpose jigs and fixtures to customer's particular requirements where no suitable standard equipment is available.

Delapena and Son Ltd. have recently concluded an agreement with the **Jes-Cal Company,** of Fraser, Michigan, U.S.A., giving Delapena & Son Ltd. exclusive rights to manufacture Jes-Cal honing tools in the United Kingdom and to sell them in the United Kingdom and certain other countries. Delapena & Son Ltd. are to manufacture and sell Jes-Cal size control hones and associated tooling to supplement their own range of precision honing equipment, thus making available in this country a proved system of mechanical automatic size control for high production honing.

Jes-Cal size control hones can be fitted to and used in conjunction with Delapena honing machines and other makes of honing machine equipped for hydraulic stone expansion. They are particularly suitable for multi-spindle machines and have their widest applicability in the automotive industries.

Delapena & Son Ltd. already have orders for the supply of Jes-Cal equipment to two major British motor companies.

THE **Electric Resistance Furnace Co. Ltd.,** a member of the Efco group of companies, has changed its name to **Efco Furnaces Ltd.** with effect from 1st December. The change became desirable due to the increased scope of the company's interests which were originally confined to electric resistance heating but have in recent years been widened to include both gas and oil-fired furnaces.

A NEW company, **Breguet-Garrett S.A.,** has been formed by the partnership, in equal shares, of three industrial organisations: one American, the Garrett Corporation; one French, Maison Breguet, and one English, Normalair Ltd., which is a subsidiary of Westland Aircraft Ltd.

The Garrett Corporation and Normalair Ltd. are prominent companies producing air conditioning, pressurisation and breathing equipment for aircraft. Maison Breguet is a large industrial organisation manufacturing electrical machinery and all classes of mechanical engineering equipment.

The object of the Breguet Garrett Company is to combine the technical design potential of the English and American companies with the manufacturing potential of the French company.

Manufacture of equipment will be carried out under licence in France and will consist initially of pressure control equipment for aircraft and air conditioning and refrigeration systems for aircraft, helicopters, missiles, automobiles, and electronic assemblies.

A PARTY of five Russians, including two women—one an interpreter—visited the Westminster factory of **Avo Ltd.**

The Russians came to study insulating materials and their applications in industry.

The leader of the party was Mr. Kalitviansky.

Thomas Industrial Automation Ltd. have reorganised their home sales force, and are opening new Sales and Service centres in London, Birmingham and Bristol.

London:
Mr. V. J. Alan and Mr. J. C. East,
39 Victoria Street,
Westminster,
London, S.W.1.
Tel.: Abbey 1816.

Birmingham:
Mr. D. R. Jones,
A. H. Lock & Co. Ltd.,
Newborough House,
Newborough Road,
Shirley,
Solihull,
Warwicks.
Tel.: Shirley 5703.

Bristol:
Mr. J. St. Alphonse,
Western Industrial Equipment Ltd.,
54 Queen Square,
Bristol, 1.
Tel. Bristol 26630.

Mr. A. Quinn has been appointed to take charge of the Service Division at Head Office, Altrincham.

MR. H. P. BARKER, chairman of **Parkinson Cowan Limited,** has announced, for the purpose of "pursuing more efficiently the rapid growth of business now in prospect" and to "allow marketing efforts to be further concentrated", it has been decided to unify two of the company's operating divisions—Parkinson Cowan Instruments and Measurement Ltd.

With immediate effect, the new division will be known as **Parkinson Cowan Measurement** and will be headed by Mr. C. H. Chambers, previously divisional manager of Parkinson Cowan Instruments.

Products of the new division include metering and automatic control equipment, a range of specialised hydraulic pumps and remote control and telemetering equipment.

THE directors of the **Griffin & George Group of Companies** have initiated a series of awards for the recognition of long service with the companies of the Group. This is being done for the first time in its 136 years of existence. The first presentations were made at the Waldorf Hotel, London, on Friday, 25th November, by Mrs. K. G. Sinclair, wife of the chairman of the Griffin & George Group, who was introduced by Mr. H. C. Mayer, financial director and secretary of the Group.

The new scheme of long-service awards provides recurring and increasing financial benefits for employees who have completed between 5 and 25 years of service. Thereafter, and in addition, presentations of gifts are made to those who have achieved 25, 40 or 50 years of service with the company.

Members of the Russian party visiting the works of Avo Ltd.

At the company's dinner on 25th November, the place of honour was taken by **Mr. R. A. Pritchard,** who has been with the group for 52 years. Seventeen members with between 40 and 49 years of service each received a gold watch. Another 50 received Parker pen and pencil sets, to celebrate their service of between 25 to 29 years.

Evans Electroselenium Ltd. have reached a trading turnover which marks a milestone in the history of the company.

With home sales 30% up on previous records, the company's big export drive has produced an increase in this market of 50%. EEL products are now being sold in more than 90 countries.

These big increases in production have called for a large expansion of factory space and the main premises at Halstead have been considerably extended. Modern administrative offices and a new machine shop have recently been completed and the building programme is being continued.

THE **Swiss subsidiary of Elliott-Automation Limited,** Elliott-Automation A.G., has moved into new and larger offices in Zurich at 32 Holbeinstrasse—Telephone 47 05 70.

In addition to Switzerland, Elliott-Automation has subsidiary companies in France, Germany, Holland, Sweden, Australia and South Africa.

As a result of the transfer of the offices of **The Telegraph Construction and Maintenance Co. Ltd.** from Mercury House, Theobald's Road, to 21 Bloomsbury Street, W.C.1, the telephone number and inland telegraphic address are now MUSeum 1600 and TELCON PHONE LONDON respectively.

SOCIETIES

THE Council of **The Institute of Physics and The Physical Society** which recently amalgamated has made the following awards:

The Duddell Medal to Dr. J. B. Adams, the Director-General of C.E.R.N. (the European Organisation for Nuclear Research), for his leadership of that team.

The Charles Vernon Boys Prize to Professor A. W. Merrison, of the University of Liverpool, for his distinguished research in experimental physics.

The Charles Chree Medal and Prize to Dr. S. E. Forbush, of The Carnegie Institution of Washington, for his distinguished work on the cosmic radiation.

The Council has also made the following appointments:

Guthrie Lecturer: Dr. D. Shoenberg, of the Royal Society Mond Laboratory, Cambridge, has been appointed Guthrie lecturer for 1961.

Thomas Young Orator: Dr. H. H. Hopkins, of the Imperial College of Science and Technology, has been appointed to deliver the Thomas Young Oration in 1961.

Brit. I.R.E. Premiums and Awards for 1959.

THE ASSOCIATED REDIFFUSION PREMIUM (Value £50): "A Gating Circuit for Single-gun Colour Television Tubes", by K. G. Freeman, B.Sc. (Graduate); and "The Testing and Operation of 4½-in. Image Orthicon Tubes", by D. C. Brothers, B.Sc.(Eng.).

THE HEINRICH HERTZ PREMIUM (Value 20 guineas): "Transistors in Video Equipment", by P. B. Helsdon (Associate Member).

A. F. BULGIN PREMIUM (Value 15 guineas): "A Rocket Borne Magnetometer", by K. Burrows, M.Sc. (Associate Member).

THE BRABAZON AWARD (Value 15 guineas): "A Low-Drain Distress Beacon for a Crash Position Indicator", by D. M. Makow, Dip.Ing., H. R. Smyth, M.B.E., S. K. Keays and R. R. Real, M.Eng.

THE LESLIE MCMICHAEL PREMIUM (Value 10 guineas): "A 6-channel High Frequency Telemetry System", by T. C. R. S. Fowler, B.Sc.

THE CHARLES BABBAGE AWARD (Value 15 guineas): "Switching Circuits using Bi-directional Non-linear Impedances", by T. B. Tomlinson, Ph.D. (Associate Member); and "Ferro-electrics and Computer Storage", by M. Prutton. Ph.D.

THE MARCONI AWARD (Value 10 guineas): "A Vidicon Camera for Industrial Colour Television", by I. J. P. James, B.Sc.

Brit. I.R.E. Graduateship Examination Prizes

THE PRESIDENT'S PRIZE (Value 10 guineas): to C. S. Sujan.

THE S. R. WALKER PRIZE (Value 5 guineas): to O. Smitk.

THE ATV TELEVISION PRIZE (Value 5 guineas): to W. W. Cridland.

CONTRACTS

Avo Ltd. is to supply 1,750 Radiac survey meter trainers to the Ministry of Aviation.

This is a new indicator which has been developed to facilitate the training of personnel in the use of instruments for the measurement of radioactivity.

The trainer is similar in size and shape to the Avo conventional nuclear measuring instrument, but is operated mechanically.

Vacuum Research (Cambridge) Ltd. have received a contract from the Admiralty for a new high vacuum brazing furnace worth more than £7,500.

This will be an electric resistance heated furnace to be evacuated to less than 10^{-4} mm mercury.

A shielded window is provided to enable the operator to view specimens within the furnace.

Three flexible thermocouples may be taken to any section of the hot zone to indicate the temperature. Two further thermocouples indicate the temperature of the heaters.

A continuous record of pressure and temperature is provided by a six-point recorder.

All the furnace controls are power operated and interlocked against failure of mains services.

Elliott Brothers (London) Ltd. have received contracts from the Ministry of Aviation for the development of training simulators.

The simulators will incorporate the new Elliott 502 computer. This computer is a special version of the recently-announced ultra-high speed Elliott 503 computer which, with its very high switching speed, will carry out complex calculations up to 1,000 times faster than most existing types of machine. The enormous work capacity of the 502 makes it capable of carrying out a large number of calculations simultaneously, an attribute which will be used to its full in the new simulator.

Teleflex Products Ltd., the remote control and mechanical handling engineers, of Basildon, Essex, have just received contracts to supply actuating equipment to two of Britain's new power stations—Richborough Power Station, on the Kent coast, and West Thurrock Power Station, in Essex.

At the coal-fired station at West Thurrock, Teleflex are providing 74 Series 3,000 actuators per boiler, and when functioning, they will be the first purely electro-mechanical actuators installed in Britain to operate fuel impellers, air registers and gas and air dampers. The two boilers, of an eventual four, are being designed and manufactured for outdoor operation by Babcock & Wilcox Ltd., and the turbo-alternator set will give an output of 200 MW. Evershed & Vignoles Ltd. are supplying the instrumentation for combustion, steam and feed water control. There will also be eight Teleflex actuators operating the isolating valves on the eight pulverised fuel mills on each of the first two boilers. The contract completion date is set for early 1961.

The second contract is to supply 74 Teleflex Series 3,000 actuators to C.E.G.B.'s pulverised fuel station at Richborough during November, 1961. This station will eventually consist of three 120 MW sets and the Teleflex actuators will control dampers on the boilers, manufactured by John Thompson (Water Tube Boilers) Limited, from a unit control desk. The Teleflex equipment is being supplied through Electro-flo Meters Company Limited, who are providing the control desks and cubicles, together with the instrumentation and automatic boiler control. Richborough is the third C.E.G.B. station to install these electronic boiler controls. No. 1 boiler is due for commissioning in June, 1962.

Teleflex electro-mechanical actuator

EXHIBITIONS, CONFERENCES, ETC.

THE Electronics and Communications Section of The Institution of Electrical Engineers are organising a **Conference on Microwave Measurement Techniques** to be held in the Institution building, Savoy Place, London, W.C.2, from the 6th to the 8th September, 1961. The topics to be discussed will include:

The measurement of microwave power, frequency, Q factor, impedance, admittance, reflection coefficient and noise.

The Organising Committee will welcome the submission of papers for consideration for inclusion in the Proceedings of the Conference, and invite intending authors to submit, as soon as possible, and preferably not later than the 15th February, 1961, abstracts of not more than 250 words for preliminary consideration.

It is proposed to associate with the Conference an exhibition of Microwave Measurement Techniques.

As a result of the recent amalgamation between The Institute of Physics and The Physical Society, The Physical Society Exhibition of Scientific Instruments and Apparatus will be known as **The Annual Exhibition of The Institute of Physics and The Physical Society.**

It will be held at the Royal Horticultural Society's Old and New Halls, Westminster, London, S.W.1 (just behind Victoria Street from Artillery Row) on the following dates:

Monday	**16th January**	**10-30 a.m. to 7-0 p.m. (Members of Press only, 10-30 a.m. to 2-0 p.m.)**
Tuesday	17th January	10-0 a.m. to 9-0 p.m.
Wednesday	18th January	10-0 a.m. to 7-0 p.m.
Thursday	19th January	10-0 a.m. to 7-0 p.m.
Friday	20th January	10-0 a.m. to 1-0 p.m.

Discourses (Demonstration - Lectures) will be given at 5-45 p.m. as follows:—

Tuesday	**17th January**	"Hydrodynamic Research", by F. S. Burt (Admiralty Research Laboratory).
Wednesday	**18th January**	"The Physics of the Oceans", by Dr. G. E. R. Deacon (National Institute of Oceanography).
Thursday	**19th January**	"Some Physical Problems in Travelling at Supersonic Speed", by Dr. D. P. Bowden (Laboratory for the Physics and Chemistry of Solids, University of Cambridge).

Tickets are available from The Institute of Physics and The Physical Society, 47 Belgrave Square, London, S.W.1.

BRITAIN'S radio and electronic component industry, with exports last year exceeding £11 million, and now running at the rate of £1 million a month, aims at increasing this figure considerably when from 30th

May to 2nd June, for the first time at Olympia, London, it holds its **17th Radio and Electronic Component Show.**

The Component Show has grown too big for Grosvenor House, Park Lane, London, where it has been held for many years, and in its home at Olympia it will be three to four times its previous size.

The R.E.C.M.F. are inviting 45,000 engineers, technicians and industrialists from all parts of the world. The exhibits will include the latest electronic applications—components for computers, machine tool controls, satellites and missiles and nuclear engineering.

Airmec Ltd. are holding a private exhibition at Denison House, Vauxhall Bridge Road, London, S.W.1, from 16th to 22nd January.

The full range of Airmec electronic instruments and industrial control equipment will be on view in addition to new developments introduced since the last exhibition, notably the high-speed oscilloscope, Type 294.

Admission to the exhibition is by ticket only, obtainable from Airmec Limited.

SERVICE

Southern Instruments has introduced a new scheme which enables comprehensive electronic instrumentation to be acquired on a rental basis.

The scheme is simple and provides an inexpensive means of obtaining equipment when it is most needed. During the hire period instruments are serviced and maintained free of charge. The equipment on hire may be purchased at any time after the first six months rental, and its purchase price takes into consideration a proportion of the rents already paid.

The scheme is operated by Southern Instruments' associated company, Instrument Rentals Limited.

EDUCATION

To meet the growing need for information on the applications of nucleonics in industry and research, **Ekco Electronics** have initiated special two-week courses at Southend-on-Sea for the technical representatives of their distributors.

A SERIES of lectures and demonstrations in **Measurement and Control Engineering** will be held by the Northampton College of Advanced Technology, St. John Street, London, during the Session 1960-61.

One series of lectures is on "Transmission and Display of Process Information". The other, on "Frequency Response Analysis and System Design for Automatic Process Control".

Both series consist of ten lectures on Monday evening, 6-30–8-30 p.m., starting 9th January.

The fee for each series is £2 2s. 0d. The application form is obtainable from the College.

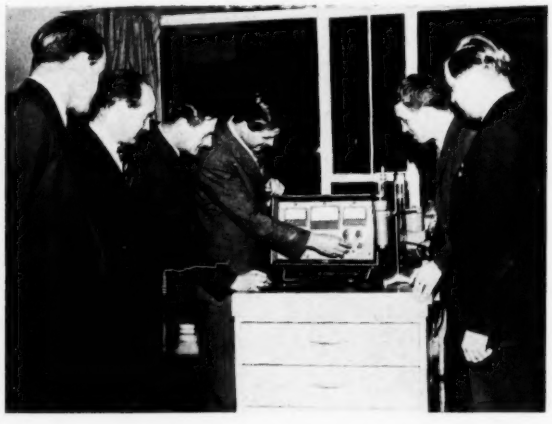
EXPORTS

MR. CHARLES W. HAYWARD, chairman of the **Firth Cleveland Group** of companies, arrived in Colombo on 17th December, on the S.S. *Oriana*, and is visiting India, Thailand, Malaya, Singapore, Hong Kong, Japan, San Francisco, Chicago, New York, and Nassau, in an extended tour in pursuance of Firth Cleveland's export policy. This policy, which has led to the setting up since the war of 28 subsidiary or associated companies in 13 countries, and a world-wide branch office agency and distribution network, has been largely inspired by the enthusiasm of the chairman.

Ekco Electronics' sales manager, Mr. E. B. Thompson, has just returned from a Middle East visit. In Beirut agreement was reached with Middle East Airlines for the expansion of their service facilities for Ekco airborne weather radar. Airline companies in the Middle East who operate Ekco equipment can now enjoy the advantage of speedier service, backed by the extensive operational experience of M.E.A. as users of Ekco weather radar on their fleet of Viscounts.

EXPORT ORDERS, totalling £25,000, have been received for the **B.P. 14-plate distillation unit** used for the rapid, economic assay of crude oil and for a wide range of laboratory distillation work in organic chemistry, from the United States, Germany, Italy and Aden, by the manufacturers, Winston Electronics Ltd.

The equipment was developed in the laboratories of the British Petroleum Co. Ltd., Sunbury-on-Thames, Middlesex.



Mr. J. Streeter (Ekco instructor) showing Mr. B. Isberg (right front), of Erik G. Ullman, Sweden, and Mr. G. Zirrgeibel (right rear) of Alfred Neye, Germany, the use of a scaler and scintillation counter for medical research. Other visitors are, left to right: Mr. T. Williams (J. Otley Rhodes Ltd.), Mr. D. H. Roberts (I.C.I. Ltd.), and Mr. A. H. Johnston (Ekco)

FORTHCOMING EVENTS

January 18th. **British Institution of Radio Engineers.** Merseyside Section. The Adelphi Hotel, Liverpool, at 7-0 p.m. "Microminiaturisation." H. G. Manfield.

January 19th. **Society of Instrument Technology.** Bristol Section. University of Bristol, Department of Physics, The Royal Fort, Bristol, 8, at 7-30 p.m. "Some Aspects of Physical Research on Tobacco." P. S. H. Boyce.

January 19th. **Society of Instrument Technology.** Newcastle Section. The Conference Room, Roadway House, Oxford Street, Newcastle-upon-Tyne, at 7-0 p.m. "Recent Advances in Photo-electronic Instruments." H. Loebl.

January 19th. **Society of Instrument Technology.** Grangemouth Section. Leapark Hotel, at 7-0 p.m. "Boiler House Instrumentation." R. Barclay.

January 19th. **Society of Instrument Technology.** East Midland Section. Nottingham & District Technical College, Burton Street, Nottingham, at 7-15 p.m. "The Electrical Synthesis of Music." A. Douglas.

January 24th. **Society of Instrument Technology.** Tees-side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7-30 p.m. "The Experimental Investigation of Space." Dr. P. J. Bowen.

January 24th. **Institution of Electrical Engineers.** Measurement and Control Section. Savoy Place, London, W.C.2, at 5-30 p.m. Discussion: "Machine-tool Control." E. H. Frost-Smith.

January 24th. **British Institution of Radio Engineers.** Southern Section. Farnborough Technical College, 89 Portsmouth Road, Horndean, Portsmouth, Hampshire. "Masers and Parametric Amplifiers." W. A. Gambling.

January 25th. **Society of Instrument Technology.** South Wales Section. Welsh College of Advanced Technology, Cardiff, at 6-45 p.m. "The Fire and Explosion Hazard of Intrinsically Safe Instrumentation.' S. J. Emerson.

January 26th. **Society of Instrument Technology.** Chester Section. Lecture Theatre, Administration Building, The Associated Ethyl Co. Ltd., Oil Sites Road, Ellesmere Port, Wirral, at 7-0 p.m. "Satellite Instrumentation." R. C. Jennison.

January 27th. **Society of Instrument Technology.** Scottish Section. Building Centre, Sauchiehall Street, Glasgow, at 7-15 p.m. Question Time.

January 28th. **Society of Instrument Technology.** Cheltenham Section. Belle Vue Hotel, Cheltenham, at 7-30 p.m. "Visit to Berkeley Power Station."

January 31st. **Society of Instrument Technology.** Manson House, London, at 7-0 p.m. "Instrumentation—Past, Present and Future:" L. S. Yoxall.

February 3rd. **Society of Instrument Technology.** Fawley Section. Administration Building, Esso Refinery, Fawley, at 5-30 p.m. "Instrumentation in Radio Astronomy." Dr. H. P. Palmer.

February 6th. **Society of Instrument Technology.** Data Processing Section. Manson House, 26 Portland Place, London, W.1, at 7-0 p.m. "The University Decision Element." Prof. J. E. Parton and A. Rose.

February 6th. **Society of Instrument Technology.** South Yorkshire Section. University, St. George's Square, Sheffield, 1, at 7-0 p.m. "Some Aspects of Instrumentation in Steelworks." Dr. R. H. Baulk.

February 9th. **Society of Instrument Technology.** Cheltenham Section. Belle Vue Hotel, Cheltenham, at 7-30 p.m. "Instrumentation at Berkeley Power Station." F. J. Benstead.

February 9th. **Society of Instrument Technology.** Liverpool Section. M.A.N.W.E.B. Industrial Development Centre, Liverpool, at 7-0 p.m. "Flame Failure Equipment." A. M. Lock.

February 10th. **Society of Instrument Technology.** Midland Section. Lecture Theatre of the Byng Kendrick Suite at the Gosta Green College of Technology, Aston Street, Birmingham, at 7-0 p.m. "Process Control." R. M. J. Withers.

February 12th. **Society of Instrument Technology.** Grangemouth Section. Leapark Hotel, at 7-0 p.m. "Flame Failure Devices."

February 14th. **Society of Instrument Technology.** Bristol Section. University of Bristol, Department of Physics, The Royal Fort, Bristol, 8, at 7-30 p.m. "The Application of Marine Instruments." E. W. Jordan.

February 14th. **Society of Instrument Technology.** Manchester Section. Nag's Head, Jackson's Row, Manchester, at 6-45 p.m. "Modern Railway Signalling Methods." C. S. Shute.

February 15th. **Society of Instrument Technology.** Newcastle Section. The Conference Room, Roadway House, Oxford Street, Newcastle-upon-Tyne, 1, at 7-0 p.m. "The Education and Training of Instrument Artificers." B. W. Ramsay.

February 16th. **Society of Instrument Technology.** East Midland Section. University, Leicester, at 7-15 p.m. "Instrumentation at the British Sugar Corporation." R. M. J. Withers.

INSTRUMENT APPLICATIONS

Automatic Loading and Unloading Equipment for Rotary Hearth Forging Furnace

AUTOMATIC loading and unloading equipment operated by compressed air for a rotary hearth furnace which pre-heats steel billets prior to forging has been designed and manufactured by The Hymatic Engineering Co. Ltd., of Redditch, Worcs. The equipment has been installed on a furnace manufactured by Franklins, of Birmingham, which is being used by Smiths Stampings Ltd., of Coventry.

The furnace was designed to operate at temperatures up to 1,300°C and to be oil fired. The oil burners are automatically controlled from billet temperature and fire tangentially round the working space of the furnace, thus requiring the unloading arm in particular to work directly in the path of one of the main burners. The hearth of the furnace is automatically indexed at a predetermined distance by a pneumatically-operated ratchet and pawl mechanism which is operated by signals from the Hymatic equipment. The jaws of the equipment have been made from Hematite heat-resistant castings and they will handle billets from 3½ in. to 6 in. square, up to 18 in. in length and weighing from 30 lb to 104 lb. The through-put rate of the furnace is controlled at 35 cwt per hour.

The doors of the furnace, which are pneumatically operated, open downwards which leaves the area above and around the furnace clear for the loading and unloading equipment.

The Hymatic equipment, which takes the form of two mechanical arms hinged at their upper points, is attached to the 8 in. × 4 in. vertical "I" sectioned buckstays which are positioned around the 15 ft diameter furnace. The loading and unloading equipment is synchronised with the furnace doors, and the mechanical movement of the doors is taken as the signal for the operation of the pneumatic equipment.

Although the furnace temperature is very high, it does not interfere with the operation of the pneumatic equipment or the air rams fitted to the outside, as the furnace is encased in an 18 in. thick firebrick outer wall, and the outside temperature is not abnormal.

The cold forging billets are transferred from the loading point on to the automatic billet lift by a gravity type conveyor. When a billet has been transferred on to the loading device it automatically rises, inserting the billet into the gripper jaws of the loading device. When the loading device has reached the top of the lift, a limit switch is operated which closes the jaws gripping the billet and initiates the return of the loading device to its normal down position, leaving the billet ready for loading into the furnace. Working in conjunction with the billet lift is a metering device which meters the billets one at a time on to the lift and ensures that a billet is not transferred on to the lift when it is in a raised position.

On receiving a signal from the timer controlling the rate of operation of the furnace, the furnace door control equipment operates, opening the doors on the loading and unloading apertures of the furnace. As soon as these furnace doors are opened the loading and unloading devices advance into the furnace; the loading device depositing the billet on to the furnace hearth and the unloading device gripping the heated billet. The devices then withdraw to their out positions. On this withdrawal stroke the furnace doors reclose and the hearth of the furnace is indexed one stroke.

When the two devices are fully withdrawn, the jaws of the unloading device open, allowing the hot billet to fall on to a discharge chute for transfer to the hammer or press.

Fitted in a control cabinet positioned close to the furnace is all the electrical equipment necessary for the automatic cycling of the furnace loading and unloading devices.

Circle **55** *for further details.*

Co-ordinated Control for Modern Fishing Vessels

THE motor trawler "D. B. FINN" launched in November from the yard of the Goole Shipbuilding & Repairing Co. Ltd., Goole, Yorkshire, for the St. Andrew's Steam Fishing Co. Ltd., has been described as a fishing machine of the highest degree. The Bloctube/Brown/Marconi control console is sited at the forward end of the wheelhouse. Bloctube Controls Ltd., of Aylesbury, have been responsible for the creation of this console, and it embodies not only their own main engine operational devices but also equipment from S. G. Brown and from Marconi Marine.

The resultant structure is compact. In the centre is a panel containing the rudder angle indicator and the S. G. Brown auto-electric steering unit. This includes automatic steering using the Arma-Brown gyro compass as datum. The steering wheel proper is a half wheel, similar to that used in aircraft. At both ends of the main console are telegraph handle type controls for Bloctube operation of the telegraphs.

The "D. B. FINN" is a starboard hand trawler and the instrumentation is so arranged. The port side panel contains the port telegraph order indicator, the Marconi Marine "Quo Vadis II" radar and one of the two "Fishgraph" echosounders. The second panel contains the dimmer switch for the indicator lights, the indicator lights themselves, a direction-finding receiver and its goniometer, and the switch for the shooting and hauling lights. Here, too, is the "Argonaut" v.h.f. radiotelephone equipment, together with the shooting clock and a switch for the winch klaxon.

Immediately to starboard of the steering control unit the upper panel carries a Sal marine automatic log. Next, in this panel, come the Marconi Marine true motion radar unit and the master control of the

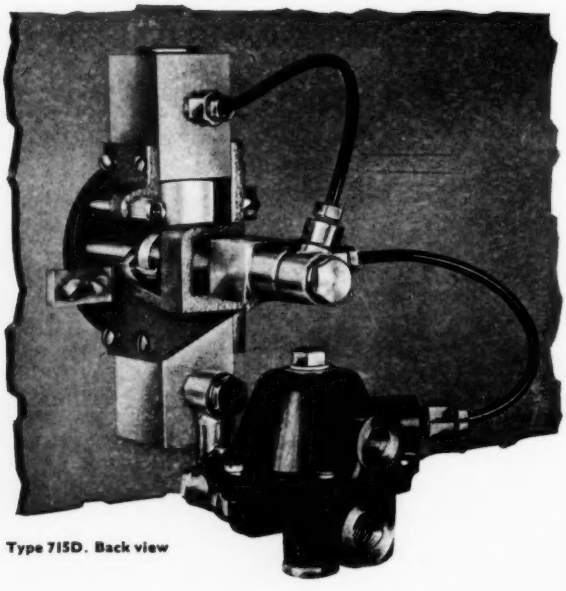
Circle **174** for further information

Front view: Common to all models

These flow indicators (Type 715 series) are versatile units, simple to install and occupying the minimum of panel space, with no awkward front of panel projections.

New flush mounting purge meters

—packaged units with pressure regulators



Type 715D. Back view

- One hole fixing
- No projections in front of panel
- Needle valve operation by coin slot
- Coin slot discourages unauthorised adjustment
- Self-contained units reduce installation costs
- Can be spaced as close as 4 in. centres

The series consists of four instruments

Type 715 A ... Simple indicator
715 B ... Indicator with needle valve
715 C ... Indicator, needle valve, and simple pressure regulator
715 D ... Indicator, needle valve, and differential pressure regulator

Leaflet I.P.2031/34 free on request

ROTAMETER

FLUID MEASUREMENT AND CONTROL
FLOW-DENSITY-LEVEL

ROTAMETER MANUFACTURING CO. LTD. . 330 PURLEY WAY . CROYDON . SURREY Telephone: Croydon 3816
G34/320

vessel's MIMCO 8-way talk-back installation, providing internal communication with working points throughout the ship. The display unit of the "Radiolocator IV" main radar equipment is at the starboard end, with the starboard Bloctube telegraph order indicator and engine room telegraph beside it.

Below the "Radiolocator IV" the lower panel carries the second of the "D. B. FINN'S" two "Fishgraph" echo-fishing equipments, with, inboard from it, a "Fishscope" cathode-ray tube fish indicator and the winch "stop" button. Beneath these are inset two loudspeakers through which the skipper can listen to messages being received in the radio room.

The arrangement is a gathering together of devices which were previously scattered all over the bridge wherever space could be found for them.

Circle **56** *for further details.*

Quality Control at Alcan's Rogerstone Modernisation

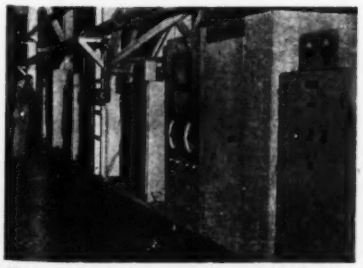
As part of the £7 million modernisation at their Rogerstone (Mon.) factory, Alcan Industries Ltd. have installed the latest in automatic controller instruments on their four soaking pits. They keep temperatures constant to within ±1°F and a check is kept on their performance by 6-point strip chart recorders.

The soaking pits are oil-burning Swindell-Dressler reheat furnaces, and instrumentation has been supplied by Honeywell Controls Ltd. Each pit has two zones, A and B, whose temperature is controlled by two electronic circular scale contact controllers. These controllers keep the soaking pit temperatures steady to ±1°F, the set temperatures being anything from 440 to 630°F depending on the material and stage of heat treatment. There is a control thermocouple for detecting the temperature and a motorised valve which is moved when the temperature goes off normal, and this adjusts the fuel oil flow. The two controllers are mounted alongside and above them is a 6-point ElectroniK strip chart recorder to give a permanent record, temperatures being detected by three thermocouples per zone.

Thermocouples are of iron-constantan in all instances and the design includes four duplex units, that is, a control and a recording thermocouple within one sheath.

Aluminium production demands close temperature control especially at the soaking pit stage. If the reheat temperature varies more than 1 degree either side, serious loss of quality could occur.

The duties of the operator are very simple. All he does is set the required temperature by means of a knob on the front of the scale and the contact controller does the rest.



Honeywell instrumentation behind four reheat furnaces at Alcan Industries

Heat treatment of up to eight hours duration prepares the aluminium for the 8,000 h.p. 144 in. rolling mill alongside, first stage in a "hot line" one third of a mile long. It is the largest aluminium rolling mill in Europe.

Circle **57** *for further details.*

Automatic Dispensing of Food and Animal Oils

One of the most interesting features in the new £2,000,000 factory of Associated Feed Manufacturers Limited, Belfast, is the method of dispensing vegetable and animal oils.

The dispensing system, designed in conjunction with Associated Feed Manufacturers Limited, is based on Parkinson Cowan Measurement rotary piston meters fitted with presetable controllers and operating solenoid type valves—all the indications and controls being grouped on a central console.

Basically, there are four different types of oil to be fed into sixteen mixing vessels. Each oil has its own independent pipework system and each mixer has four inlet connections. Thus, any combination of oils can be fed into the mixers.

To control the batch dispensing, the operator presets on the appropriate dial on the control console the amount of oil to be dispensed. He then rotates a selector switch to register a similar amount to that set up on the preset dial. This selector switch controls four proportioning solenoid valves, each adjusted for varying rates of flow. In this way the time taken to dispense the oil will be the same, no matter what quantity is set up on the dial.

The operator then selects the mixer into which the batch is to be dispensed by means of the mixer selector switch.

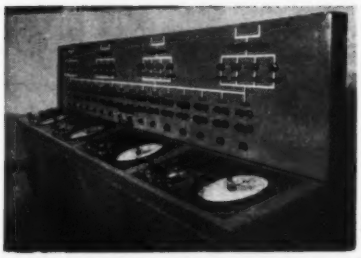
On the assumption that the batch is to be dispensed automatically, he next ensures that the changeover switch is set in the automatic position and then presses the "start" button. The circuit is now prepared for dispensing.

At this stage, other control apparatus feeds meal into the appropriate mixer. When the level of the meal reaches the "depth" probe in the mixer, the solenoid valve for the appropriate oil or oils is opened and the dispensing continues until the preset amount has been fed in. When this point is reached the equipment automatically closes the valve and resets the batch quantity controller to the same quantity ready for the next batch. Dispensing, however, cannot take place for a further batch until the operator has pressed the "start" button again.

Various signal lights on the mimic diagram indicate to the operator which oil has been selected and into which mixer it will be dispensed. Four signal lamps are grouped together at the top of the control panel to indicate which of the four proportioning valves are in operation.

If a mixer is used to store material overnight, a material level light on the control panel is illuminated and indicates to the operator that the mixer is in use and cannot therefore have oil dispensed into it.

Provision is made on the Parkinson Cowan Measurement control system so that if the "depth" probe circuit for automatic control develops a fault, the operator has the facility of moving a changeover switch to "hand operation"; this means that safety interlocks are overridden and dispensing can continue under visual supervision from the control console.



Parkinson Cowan Measurement control console for automatic dispensing of oils

Circle **58** *for further details.*

Clarity Tests for Transparent Plastics

The Eel spherical haze meter is a photo-electric device which has been designed in accordance with a specification published by the American Society for Testing Materials which gives a standard method of test for haze and luminous transmittance of transparent plastics (Ref. ASTM D.2003-52).

To the manufacturer of such plastic products it not only offers an accurate means of assessing the degree of haze present, but also provides an accurate method of standardising and indexing various finishes.

To users it not only establishes the clarity of the materials they have purchased, but enables them to order the transparent plastics best suited to their requirements.

The Eel spherical haze meter consists of a light source, a suitable lens system, a spherical light integrating chamber, and a photocell unit.

Light from a 12 volt 36 watt tungsten filament lamp (equivalent to source A in the specification ASTM D.1003-52) is directed through the lens system to form a circular uniformly illuminated light spot of pre-determined size, located centrally within the exit port of the sphere. This port is fitted with a light trap which provides a low blank reading. The sphere may be pivoted through a small angle, when the beam of light falls entirely upon the white coated inner surface. This is used as a reflectance standard.

The specimen plastic is held by a spring clip situated at the entrance port to the sphere and measurement of scattered light within the sphere is made by a photocell mounted at right angles to the beam, and screened from direct viewing of this beam. The photocell is fitted with a correction filter to bring its spectrum response to that of the "average" eye. A gauze filter is normally positioned in the light beam and can be removed to give increased readings on samples of low haze.

Readings are provided by the Eel Unigalvo Type 25 which incorporates a taut suspension galvanometer mounted in a sealed plastic body and housed with projection lamp, controls and scale, in a grey hammer finished cast aluminium case.

It is manufactured by Evans Electroselenium Ltd.

Circle **59** *for further details.*

Circle 175 for further information

Sintered COMALLOY

A MACHINEABLE PERMANENT MAGNET ALLOY

Energy product

$(BH_{max.})$ 1.0 × 10^6 gauss-oersteds.

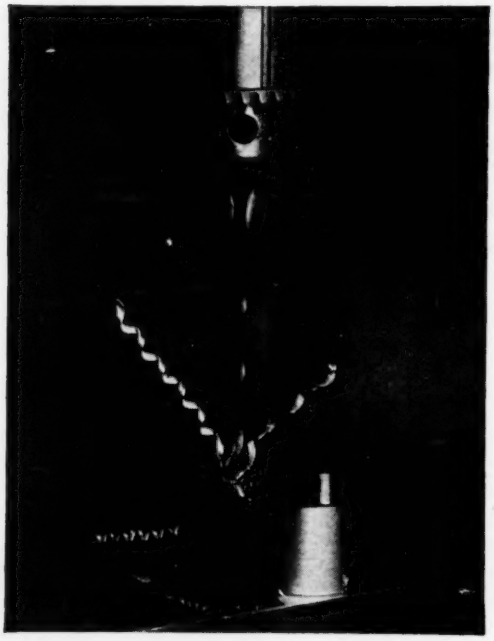
Properties

The comprehensive range of Murex sintered magnet alloys has been extended by the addition of this isotropic alloy having a remanence of 10000 gauss and a coercivity of 250 oersteds.

Machineability

Prior to final heat-treatment, the machining characteristics of Comalloy are similar to those of mild steel. This advantage together with the advantages inherent in a sintered material, simplifies many design and manufacturing problems.

A leaflet giving details of physical and magnetic characteristics can be provided upon request, and technical personnel are available to advise customers in the application of Comalloy and other permanent magnet alloys manufactured by Murex Ltd.



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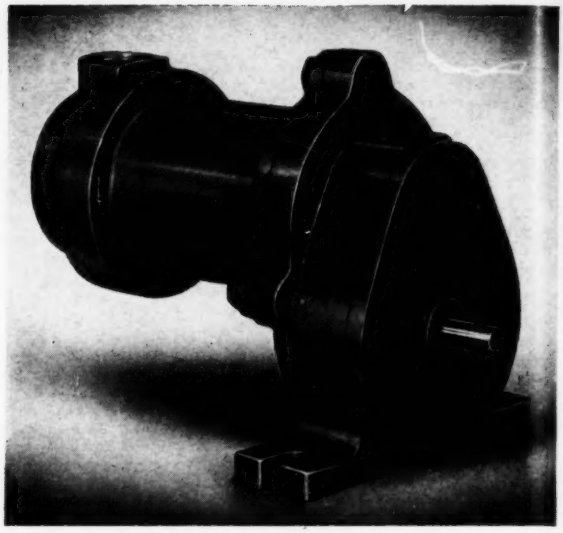
Telex 28632 Telegrams: Murex, Rainham-Dagenham Telex.
London Sales Office: Central House, Upper Woburn Place, W.C.1. *Tel. EUSton 8265*

Circle 176 for further information



AN A.C. TACHOGENERATOR FOR LOW-SPEED DRIVES

The L.S.E. tachogenerator incorporating 4 : 1 gearbox has a terminal voltage (at 250 r.p.m.) of 30·5 V. ± 1% into 10,000 ohms, with low friction-torque and moment of inertia.

Other leading data includes:—

Winding	Three-phase, star-connected
Terminal Resistance	260 ohms
Terminal Impedance at 750 r.p.m.	300 ohms
Harmonic Content of Voltage Waveform on Load	Less than 1%
Short Circuit Capacity	10 seconds at 750 r.p.m. will not change the output by more than 0·1%

Brief details of other tachogenerators, magslip transmitters and servo motors are given in Publication 444
Please apply for a copy to:
Laurence, Scott & Electromotors Ltd.,
Publicity Department,
376 Strand, London, W.C.2

LAURENCE, SCOTT & ELECTROMOTORS LTD.

INSTRUMENT DEPARTMENT,
OPENSHAW, MANCHESTER, 11

PERSONALITIES

J. K. Laughton

E. E. Jones

Mr. J. K. Laughton has been appointed divisional manager of the Telecommunications Division of The Plessey Company Limited.

Mr. Laughton has been with Plessey since early 1958 when he joined the Telecommunications Division as sales engineer. Thereafter, he became successively, sales manager, executive assistant to the general manager, and manager of the Division's advanced development laboratory at West Leigh, Hampshire—from which position he takes up his new appointment.

Mr. Eric E. Jones, group commercial director of the Solartron Electronic Group Limited, is leaving to become managing director of Adrema (Holdings) Limited, Telford Way, London, W.3, and its subsidiaries, including the Bradma Companies. He will at the same time become European vice-president of the Farrington Manufacturing Company, Needham Heights, Massachusetts, U.S.A., the parent company of Adrema (Holdings) Limited.

Mr. Claude Laurence has resigned from the board of Laurence, Scott & Electromotors Ltd., after thirty-seven years' service. His son, **Mr. J. A. Laurence,** has been appointed to the vacancy thus created. Mr. J. A. Laurence, like his father, is a member of the Stock Exchange, London.

Mr. A. A. Price has been appointed by IBM United Kingdom Limited as IBM account manager to the United Kingdom Atomic Energy Authority. This responsibility will include the administration and co-ordination of IBM data processing installations in the several locations of the Authority.

Mr. Price has had experience in a number of IBM data processing installations prior to this appointment and has worked for two years with IBM computers installed with the UKAEA.

Mr. Michael Clark, director of The Plessey Company Limited, announces the appointment of **Mr. N. L. Lupton, M.A., A.F.R.Ae.S., A.S.M.A.,** as contracts manager of the Electronics and Equipment Group.

He relinquishes the position of commercial manager with Microcell to join The Plessey Company Limited.

Mr. John Boardman has been appointed chairman and chief executive of the Burtonwood Engineering Co.

Mr. Boardman was formerly deputy to the present chairman, Mr. R. Dutton Forshaw, who has resigned from the board. Also appointed to the board of Burtonwood is **Mr. Bernard C. Shrubsole,** joint managing director of U.S. Industries Inc. (Great Britain) Limited, the European based company of U.S. Industries.

Burtonwood Engineering was acquired by U.S. Industries in October, 1959, as a manufacturing facility for the European market.

Mr. C. P. Dotson, chairman of Texas Instruments Limited, has accepted the resignation of Mr. Dudley Saward as managing director, and **Mr. A. N. Provost** has been appointed managing director in succession to Mr. Saward.

Mr. J. D. Dale-Lace, A.M.I.E.E., D.F.H., has been appointed sales manager of Radio Components and Special Products Department, A.E.I. Radio & Electronic Components Division. Mr. Dale-Lace was trained as an electrical engineer at Faraday House, where he obtained the Faraday House Diploma in Electrical Engineering.

Mr. Clifford E. Passmore, age 31 years, has been appointed field sales manager for the Midland Region of Griffin & George (Sales) Ltd.

He will now be centred at the Midland Regional Headquarters of Griffin & George, at Frederick Street, Birmingham.

Mr. Paul S. Delapena, previously manager of Delapena's London office, has been appointed to the board of Delapena & Son Ltd. as sales director and has moved to the company's head office at Tewkesbury Road, Cheltenham. He is to be responsible for the sales of both the Induction Heating and Honing Divisions of the firm. The company's sales organisation has been streamlined and centralised on the head office and the London office has been closed down, the premises having been handed over to Balzers High Vacuum Ltd.

Mr. J. F. C. James, who for the past seven years has been responsible for service and pyrometer supplies for Honeywell Controls Ltd., Birmingham Office, has recently been appointed Technical Sales representative for the Midlands Area of Sifam Electrical Instrument Co. Ltd.

Mr. R. G. Roberts has been appointed sales manager of W. H. Sanders (Electronics) Ltd.

Mr. R. M. Baerlein has been appointed senior sales engineer.

Mr. H. A. Barratt, chief engineer of Wallace & Tiernan Ltd., has been appointed to the board of E.C.D. Limited, Tonbridge, Kent, a subsidiary company specialising in pumping and air conditioning equipment. The major part of the production side of the Wallace & Tiernan Chiswick works has been transferred to a new factory at Tonbridge and further extensions are now under way. Mr. Barratt, who still retains his post of chief engineer of Wallace & Tiernan Ltd., will be largely concerned in supervising future expansions at Tonbridge.

Mr. Barry Rogel, B.Sc.(Eng.), A.M.I.E.E., has left Wayne Kerr Laboratories Ltd. to take up an appointment as managing director of the newly-formed subsidiary of the Rosemount Engineering Company, Minneapolis, U.S.A. He will continue to act as consultant to Wayne Kerr and in this capacity joins Professor A. L. Cullen, Ph.D., M.I.E.E., O.B.E., Professor of Electrical Engineering at the University of Sheffield, and V. S. Griffiths, Ph.D., F.R.I.C., Reader in Spectroscopy at the Battersea College of Technology.

Mr. Rogel led the Wayne Kerr microwave design team, and in recent years has made a special study of the measurement of semiconductor parameters to extend the use of Wayne Kerr transformer bridges. In September he lectured on this subject to the 5th International Instruments & Measurements Conference in Stockholm.

Colonel H. A. Lewis has relinquished his appointment as managing director of E.M.I. Sales and Service Ltd. to take up the appointment of managing director of Newmark (London) Distributors Ltd. at Newmark House, 143/149 Great Portland Street, London, W.1.

Mr. B. Kennard has been appointed area manager for the Northern, Home Counties, East Anglian and East Midlands territories of Radiospares Ltd.

J. F. C. James

B. Kennard

C. A. P. Cannon

H. A. Coates

Mr. C. A. P. Cannon recently completed 21 years' service with Measuring Instruments (Pullin) Ltd., and was presented with a gold watch by Mr. J. P. Steward, managing director.

Mr. H. A. Coates, who has been chief accountant of Measuring Instruments (Pullin) Ltd. since 1944, has joined the board of directors.

As a consequence of the death of the company's chairman, Sir Cecil Weir, the directors of International Computers and Tabulators Limited announce new appointments.

Pending the appointment of a chairman **Mr. H. V. Stammers** is appointed acting chairman. **Mr. C. Mead** to be a deputy chairman, **Mr. J. Bull** to be managing director.

Mr. N. T. Atkinson, formerly head of Ekco Television Development, has been appointed to the post of chief of Television and Radio Development. Mr. Atkinson has been concerned with the development of Ekco television receivers since 1938 and in his new position he will be directly responsible to executive director and chief engineer, Mr. A. J. Brunker. **Mr. E. W. Maynard,** formerly in charge of Export Television Development, succeeds Mr. Atkinson as head of Television Development.

With the recent acquisition of a 13-acre site near Southend to permit the centralising of Ekco Electronics' activities in the Southend area, individual responsibilities within the company have been reorganised to take advantage of the expanded facilities.

Mr. P. L. Stride, formerly manager of the Malmesbury Works, becomes manager of the Aviation Division, handling the design and technical liaison for ground and airborne equipment for the aviation industry including the recently-introduced v.h.f. automatic direction finder and the airborne weather radar equipment.

Mr. P. J. Harvey, formerly chief electronics engineer, becomes manager of the Nucleonics and Industrial Division, which is responsible for research and development covering nucleonic and physical instrumentation and control. The division is engaged in the application of these techniques in research and medicine, industry and reactor instrumentation.

Mr. E. B. Thompson continues handling the commercial activities of both divisions as sales manager.

MANUFACTURERS' LITERATURE

Microsignal Chopper

The Electromechanical Division Research Laboratories of Ericsson Telephones Ltd. have recently produced a data sheet which gives information on the Ericsson microsignal chopper Type D. The Type D has been specially designed for applications where electrical noise has to be kept to a minimum. Design is based on the magnetically and geometrically-balanced system used in earlier polarised relays and choppers.

Circle **60** *for further details.*

Thermocouples and Compensating Cables

Information Sheet No. 31, issued by Pyrotenax Ltd., presents details of the thermocouple units and compensating cables manufactured by the company. Price list supplements are attached.

Circle **61** *for further details.*

C. F. Casella & Co. Ltd.

C. F. Casella & Co. Ltd. recently published a brochure to celebrate their 150th anniversary. The brochure contains an interesting account of the company's history, and, at the back, a list of the current literature which the company has available. The centre section contains illustrations and descriptions of a range of instruments supplied by Casella.

Circle **62** *for further details.*

Ultrasonic Testing Equipment

The new Ultrasonoscope catalogue is designed not only to set out the comprehensive range of equipment available, but also to be a valuable fundamental reference book for the newcomer to the field of ultrasonic non-destructive testing. More than half the space is devoted to the basic principles of ultrasonic testing and descriptions of some of the techniques used for the more common applications.

Circle **63** *for further details.*

Vyon

So that prospective customers will have a broad outline of some of the main applications for which Vyon can be used, a special booklet has been published by Porous Plastics Ltd.

Vyon is a new porous plastic material. It is made from high density polyethylene of the Ziegler type and the permeability may be varied to suit different applications. It is light and flexible, very strong and is easy to machine and fabricate.

The booklet gives details of some of the many applications for Vyon, including its use as a filter material for liquids and gases, the aeration of powders for conveying and dip coating, electrolytic diaphragms, and for orthopaedic splints and appliances.

Since it is chemically inert as well as non-absorbent, it is of particular value to the food and chemical industries.

The booklet contains data tables which give examples of Vyon's permeability and full details of the sizes of sheets, rolls and tubes which are available.

A tuck-in flap on the inside of the booklet's back cover contains loose-leaf sheets which give specialised information on the use of Vyon for air and liquid filtration and air fluidised powder conveying.

Circle **64** *for further details.*

Draught and Pressure Instruments

In List 47/1 Cambridge Instrument Co. Ltd. have published a complete list of draught and pressure indicators, recorders and controllers produced by the company. The catalogue includes sets of tables giving reference numbers, ranges, weights and dimensions, and standard charts available for various recorders.

Circle **65** *for further details.*

Pneumatic Temperature Measuring

List 331/1 published by Cambridge Instrument Co. Ltd. gives details of the Cambridge pneumatic temperature-measuring system for temperature indicating and recording over distances up to 500 ft. Temperature is automatically converted into equivalent air pressure signals by a simple instrument which transmits a signal to recorders, controllers and/or indicators. Any number of indicators and recorders can be installed at points along a single air/temperature transmission line.

Circle **66** *for further details.*

CO_2 Recovery and Control

List 333, published by Cambridge Instrument Co. Ltd., gives details of the Cambridge CO_2 recovery panels. The equipment described provides an automatic method of analysing CO_2 and controlling CO_2 collection systems. It has been designed and developed by the Research Department of the company in consultation with British and Continental brewers.

Circle **67** *for further details.*

"Numalec" Controller

Cambridge Instrument Co. Ltd. Temporary List 310 gives details of the company's "Numalec" controller. The controller has been designed to give accurate programming control of processes such as washing and sterilising, rubber and plastic process cycles, plating, etc. It is basically an electro-pneumatic controller employing either one or two Bourdon-type measuring systems.

Circle **68** *for further details.*

Extrusion Speed Transmitter

Temporary List 249/2, published by the Cambridge Instrument Co. Ltd., sets out information on the extrusion speed transmitter produced by the company. The transmitter continuously measures the ram speed of hydraulic extrusion presses or any other machine producing a linear or equivalent rotational movement that can be coupled to the transmitter, and converts this varying mechanical quantity into a proportional electric current that will operate any number of separate indicators and recorders.

Circle **69** *for further details.*

Universal Vibrograph

Leaflet 62/1, published by Cambridge Instrument Co. Ltd., provides information on the Universal Vibrograph produced by the company. Some space is devoted to possible applications, including horizontal and vertical vibrations, rotational vibrations, spot tests, deflections, and low frequency usage.

Circle **70** *for further details.*

Electronic Temperature Indicators

Electrothermal Engineering Ltd. have produced a new booklet on "Electronic Temperature Indicators".

Detailed information is set out on the Tastotherm, Types G & GB, designed for the measurement by contact of temperatures up to 400°C. Also described is the Tastotherm Infra, designed for the measurement by radiation of temperatures up to 3,000°C.

Circle **71** *for further details.*

Component Reference Booklet

A fourth edition of their component reference booklet has been issued by Electrothermal Engineering Ltd. Technical data on a number of new items is included. Joint Service (N.A.T.O.) style reference numbers have been included where applicable.

Circle **72** *for further details.*

Electronic Components

Electrothermal Engineering Ltd. have now published a second edition of their catalogue, "Resistors, Valve Retainers and Other Electronic Components".

The catalogue has been prepared on the basis that where resistors are to form a critical part of a circuit it is not sufficient to specify only resistance values, tolerance and wattage; accordingly in this catalogue all relevant data has been presented.

Circle **73** *for further details.*

Portable Air Compressors

B.E.N. Patents Ltd., of High Wycombe, Bucks., have issued a new leaflet (CB.195), entitled "Portable Air Compressors".

A wide range of units is illustrated, and data is provided on performance, pressure, h.p. requirements, dimensions and weight. Specifications are given in both British and metric measurements.

Circle **74** *for further details.*

Inspection Service

A booklet has recently been produced by Solus-Schall Ltd., which provides information concerning the company's Inspection Service. The booklet has been designed to show how such a service can reduce production costs.

Details are given of the site-inspection methods employed, including radiography by X- and gamma rays, ultrasonics and penetrants.

Circle **75** *for further details.*

Laboratory Equipment and Precision Tools

A new catalogue has been compiled by Henri Picard and Frère Ltd., in which are listed the British-made goods which this company distributes to industrial laboratories and to manufacturers of precision equipment, both at home and overseas.

The majority of the 2,000 items which appear in this illustrated catalogue will be primarily of interest to watchmakers and jewellers, but a number of items of industrial interest are included.

Circle **76** *for further details.*

V.L.F. Function Generator

A recent leaflet by Advance Components Ltd. provides details of the company's v.l.f. function generator Type SG88. The SG88 is an instrument based upon a novel optical/mechanical system involving rotating discs, with opaque waveform patterns and combing accuracy with flexibility. It has been produced to solve many simulation and computer design problems, for servo-system analysis, vibration testing, and other similar applications. Its use obviates the need for specially shaped and wound potentiometers, and complex electronic wave-shaping circuits.

Circle **77** *for further details.*

Transductors

A recent W. H. Saunders (Electronics) Ltd. leaflet gives information on four of the company's transductors. These are the Type 1000 encapsulated transductor, the Type 2000 open-type transductor, the Type 3000 transductor which uses toroidal cores, and the Type 4000 transductor, supplied as either a 1-, 2-, or 3-element assembly. The Saunders transductors are suitable for use in automatic control systems, and applications where size, weight and quality are of importance.

Circle **78** *for further details.*

Photographic Lenses

A recent catalogue issued by J. H. Dallmeyer Ltd. contains particulars of Dallmeyer lenses and apparatus for amateur photography and cinematography. A catalogue is also available which lists the industrial lenses designed and manufactured by the company.

Circle **79** *for further details.*

Protective Packaging

A new booklet, "Shock Protection in Packaging", produced on behalf of the Expanded Rubber group of companies, deals with the protection of goods in transit. Part of the booklet is devoted to shock damage and its elimination, and the theory of cushion design. The cushioning and protective materials made by the E.R.C. group are described.

Circle **80** *for further details.*

Air-operated Receivers

Negretti & Zambra's Catalogue B/21, recently published, describes the company's air-operated receivers. A general description of each receiver indicator, recorder or controller is given; full technical details are available in separate specification sheets relating to each model.

Circle **81** *for further details.*

Crusilite Tube Furnace

The Crusilite Department of The Morgan Crucible Co. Ltd. have recently published a leaflet, "Crusilite Tube Furnace", which gives information on the building of electric furnaces. The furnaces referred to are claimed to be suitable for all temperatures up to 1,575°C, and simple to construct, materials and instructions being available from The Morgan Crucible Co. Ltd.

Circle **82** *for further details.*

"Platinum Metals Review"

The October, 1960, issue of *Platinum Metals Review*, published by Johnson, Matthey & Co. Ltd., contains a number of useful and informative articles. Among the subjects dealt with are "The Metal-clad Thermocouple", "Thermal Expansion of Rhodium-platinum Alloys", "High-temperature Brazing of Heat-resisting Materials", and "Improved Stainless Steel Reactor Materials".

Circle **83** *for further details.*

Radio-frequency Heating

The first part of an article on "Radio-frequency Heating" is presented in *Technical Notes* 213 published by CIBA (A.R.L.) Ltd. The article is illustrated, and this part of it deals with the general principles of the subject, glue-line heating, through heating and stray-field heating, feeders, and generators. The second and final part of the article is to be published in the next issue of CIBA(A.R.L.) *Technical Notes*.

Circle **84** *for further details.*

Automatic Lighting Control

Leaflet E1631-01 of Lancashire Dynamo Electronic Products Ltd. gives information on the company's Automatic Lighting Control, Series ALC.3, a unit designed to provide automatic switching of lights from daylight level. Housed in a compact, Neoprene-sealed, cast light alloy case, the unit can be arranged for direct plug or wall mounting, or to plug in to a pole or wall mounting socket if desired. Output, due to incident daylight, of a photo-cell selected for correct spectral response, is measured by means of a suitable electronic circuit which operates the internal electromagnetic relay at a pre-determined level of daylight.

Circle **85** *for further details.*

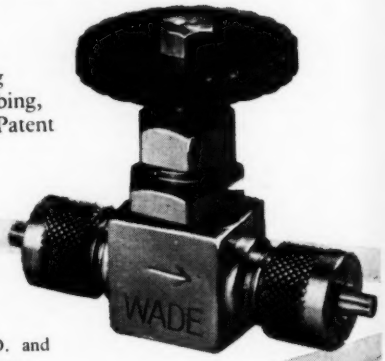
Internal Micrometer

The measurement of blind bores and other special internal dimensions by the TESA TRI-O-BOR internal micrometer is described in a new 12-page illustrated brochure. The operation of this instrument is clearly defined and this, combined with the general specification, makes this brochure useful for those interested in the fine measurement of internal bores, threads, grooves, blind bores, etc.

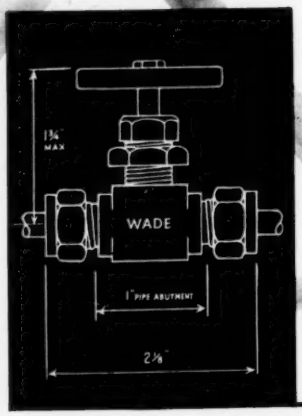
Join up with WADE

For Copper Tubing ¼" and 5/16" O.D.

Here is a good looking Medium Pressure Valve, made in high quality brass, with a Plastic Handwheel. It can be used for Copper, Nylon or Plastic Tubing. For Nylon, replace the Copper Compression Ring with the "N" Ferrule. For Plastic Tubing, these Valves are supplied with the Patent Wade "P" Joint, now in universal use.



For Nylon Tubing (with "N" ferrule)
¼" O.D. x 3/16" I.D.
¼" " x 5/32" "
5/16" O.D. x ¼" "
5/16" " x 3/16" "



For Plastic Tubing
¼" O.D. x 5/32" I.D. and
5/16" O.D. x 3/16" I.D.

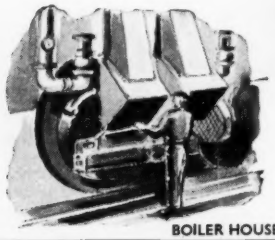
WADE COUPLINGS

WADE COUPLINGS LIMITED

270, High Road, ILFORD, ESSEX.
Telephone: ILFord 1185/6/7.

Rototherm

The DIAL THERMOMETER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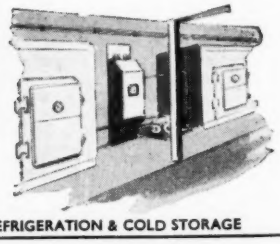
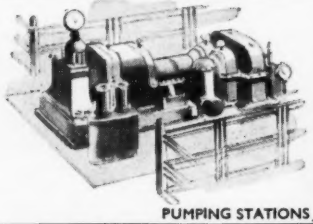

REFRIGERATION & COLD STORAGE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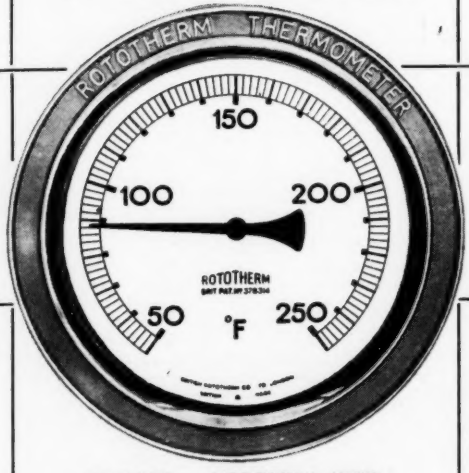

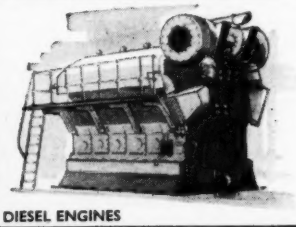
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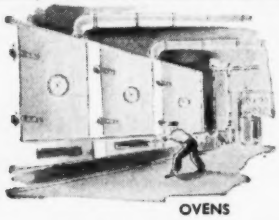
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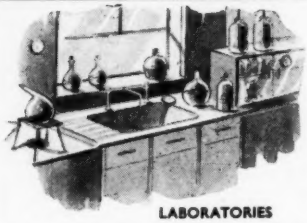
LABORATORIES

BI-METAL · MERCURY-in-STEEL VAPOUR PRESSURE

THE BRITISH ROTOTHERM CO. LTD., Merton Abbey, London, S.W.19. Tel. LIBerty 7661 (6 lines)

Also now available are the TRI-O-BOR specification sheets B52, B52/1, B53, B53/1, B55 designed to fit the TESA General Catalogue. Holders of these catalogues who have not received these sheets can obtain them by application.

Circle **86** *for further details.*

Laboratory Equipment

Loughborough Glass Co. Ltd. have published a new catalogue in which are listed the products of the company available from stock. The main body of the catalogue is set out in similar form to its predecessors, sections appearing on interchangeable laboratory glassware, plastics laboratory equipment, and general laboratory equipment. A new feature of the present publication is a specialities section which is presented at the beginning of the catalogue.

Circle **87** *for further details.*

Industrial Electronic Equipment

A brief but informative synopsis of what has been achieved by the AEI Electronic Apparatus Division is given in a well designed, profusely illustrated publication (4051-81, Ed. A), just issued, in colour, by the AEI (Rugby) Advertising Department. The publication imparts an insight into what can still further be accomplished to reduce costs and increase efficiency in a great many existing and new industrial processes, and includes sections on electronic motor control, power magnestats, static switching, welding controls, voltage regulators, electronic timers, high frequency heating, photo-electric equipment, control of paper machine drives, crane approach warning system, "Clear-call" carrier-frequency communication system, safety devices, etc.

Circle **88** *for further details.*

EMIDEC 1100

E.M.I. Electronics Ltd. have recently produced a brochure which describes in detail six typical uses of the EMIDEC 1100 all-transistor data processing system. Applications described range from production control to hire-purchase accounting; chapters are included on payrolls, and current accounting for banks. Each section is illustrated by a typical flow chart.

Circle **89** *for further details.*

"Connectors Digest"

Transradio Ltd. have published a new catalogue entitled, "Transradio Connectors Digest". This illustrated catalogue contains detailed information of more than 200 connectors. Useful cross-reference lists are included, and service numbers are given. Copies are available from the company free of charge.

Circle **90** *for further details.*

Apprenticeship

Negretti & Zambra have published an interesting brochure on "Apprenticeship". This describes the general conditions of apprenticeship at this company, and the company's Craft Apprenticeship, Engineering Apprenticeship, and Student Apprenticeship Schemes.

Circle **91** *for further details.*

Slow-motion Stroboscope

Dawe Instruments Ltd. have recently published an illustrated leaflet on the company's Type 1206 slow-motion stroboscope. The Type 1206 stroboscope oscillator unit provides two outputs, one to drive a power amplifier and vibration generator, and the other at a constant difference frequency to trigger a stroboscope, thus achieving the slow-motion effect of the component being examined.

Circle **92** *for further details.*

Imhof International Catalogue

Alfred Imhof Ltd. have produced an international version of their catalogue of racks, cases, consoles, handles and other accessories. Each item appears in ten languages.

Circle **93** *for further details.*

Ribbon Feeder Connector

Belling & Lee Ltd. have recently produced a leaflet on the "Belling-Lee" ribbon feeder connector. The ribbon feeder is a flat, flexible, insulated ribbon, containing a number of parallel copper foil strip conductors. The new cable is described as having particular application where space is limited, or where cable needs to withstand frequent flexing, but its primary purpose is the interconnection of printed circuits. Belling & Lee have developed a range of 8-way and 18-way connectors for this cable, using an adaptation of the "Belling-Lee" printed circuit connector L.1369, and a plug member of printed circuit construction.

Circle **94** *for further details.*

Transformer Ratio-arm Bridge

The Wayne Kerr Monograph No. 1, produced by the Wayne Kerr Laboratories, contains an article by Mr. R. Calvert, a technical director, entitled "The Transformer Ratio-arm Bridge". Attention is drawn to the practical arrangement of the bridge; and the extending of the range of measurement is also discussed.

Circle **95** *for further details.*

TCC Bulletins

Special Products Bulletin No. 9 in the TCC Technical Bulletin series sets out particulars of "Flexistrip", a joint development of BICC and TCC. Technical Bulletin No. 68 concerns TCC miniature tubular condensers, Types CE 131, CE 132, CE 133, and CE 134. Technical Bulletin No. 70 details sub-miniature tubular electrolytic condensers, Types CE 69, CE 67, and CE 58; Bulletin No. 71 refers to TCC miniature tantalum anode condensers, polarised and non-polarised; Bulletin No. 72 describes TCC miniature tropical paper condensers of similar construction to the "Metalmite" range.

Circle **96** *for further details.*

Selenium Rectifiers

Bulletin SR-2006 of the International Rectifier Co. (Great Britain) Ltd. describes the range of stock selenium rectifiers from which the firm can give immediate delivery. These rectifiers are designed to meet the most commonly required outputs, i.e., h.t. supplies for electronic equipment, radio and television, also l.t. outputs for battery charging and transistor supplies. Prices of these stacks are listed.

Circle **97** *for further details.*

Printed Circuit Design

A handbook on printed circuit design has recently been published by Tectonic Industrial Printers Ltd. This has been prepared as an initial guide to printed-circuit design, and has been kept as simple as possible.

Circle **98** *for further details.*

"Computer News"

The October, 1960, issue of *Computer News*, Vol. 1, No. 12, contains the first part of an informative article on "Reactor Shutdown Transients". An account is given of "Function Generation on the Short Computer". The news section of the publication presents information on two Short computer developments, the medium-capacity Simlac minor, and an educational computer.

Circle **99** *for further details.*

Simlac

A recent Short Brothers & Harland publication contains technical information on the company's new multi-unit analogue computer, the "Simlac". This computer incorporates new wiring techniques and a new patching system which eliminates cord clutter. The flexible selector system and associated problem check are claimed to be unrivalled in the analogue computer field. Component absolute accuracy is said to be better than 0·01%.

Circle **100** *for further details.*

Teleprinters

Creed & Company Ltd. have published a brochure which illustrates and describes the teleprinter network of Bakelite Ltd. Indication is given of the tendency today for companies with dispersed plants to use private-wire teleprinter networks to speed the flow of information between the various points within a group. The system operated by Bakelite Ltd. can handle a yearly volume of 150,000 orders, and 50,000 business messages.

Circle **101** *for further details.*

Flowmetering Transmitters

Fischer & Porter Ltd. have recently published a catalogue presenting the company's range of flowmetering transmitters and secondary indicators, recorders, controllers and integrators.

Pneumatic, electric and electronic transmitters for use with variable-area flowrators are described, and, in addition, the Fischer & Porter differential pressure transmitter for variable-head flowmetering applications. A complete range of pneumatic, electric and electronic secondary receiving instruments is presented in a further section of the catalogue.

Circle **102** *for further details.*

"Plessey International News"

The October, 1960, issue of *Plessey International News* contains an account of aspects of the manufacture of electrolytic capacitors at Plessey's Swindon works. A description is also given of applied electronic research at the Plessey

Research Establishment at Roke Manor. A technical article, "Multichannel Pulse Height Analyser for use in Gamma Spectroscopy" is presented, and a further article on "Some Thoughts on Future Tasks in Aviation" is also featured.

Circle **103** *for further details.*

"Technique"

The October, 1960, issue of *Technique*, Vol. 14, No. 4, contains a number of short technical articles of interest. D. Tomkinson gives an account of "The use of an Impedance and Angle Meter on Rented Protection Pilots", and P. M. Williams B.Sc., describes "The use of a Phasemeter for the Measurement of Group Delay Variations in Television Signals". Mr. John Bell, technical director of Muirhead & Co., Ltd. writes on "The Muirhead-Pametrada Integrating Power Meter".

Circle **104** *for further details.*

Flow Controlled Switches

Nash & Thompson flow controlled switches are described in a recent leaflet issued by Nash & Thompson Ltd. These Nashton electrical switches are operated by liquid flow for use as safety devices to enable corrective action to be taken when the flow rate varies outside predetermined limits. Various models are available in gun-metal or stainless steel, covering a range of flow rates to suit most applications.

Circle **105** *for further details.*

Metallurgical Equipment

A leaflet recently issued by Nash & Thompson Ltd. gives information on items of Nashton metallurgical equipment now available. These include instruments for testing the thickness of a wide range of surface finishes; among these instruments are the B.N.F. plating gauge Mk. 11, the Magne-gage thickness tester, the Kocour thickness tester, and the Accuratest thickness tester. Creep-testing machines described are the Type 100, the Type 102, and Type 104. Other instruments presented are metallurgical mounting presses, a micro-hardness tester, and various polishers.

Circle **106** *for further details.*

Silicone Spray

Amber Oils Ltd. have recently issued a leaflet which describes in some detail the Ambersil silicone sprays which the company produces. Formula One is a pure methyl silicone fluid of high lubricity, high heat-resistance and low surface tension. It has a flash point of 600°F and a spontaneous ignition temperature of 900°F. Formula Two is the same pure methyl silicone but with the addition of an appropriate solvent which makes for a finer spray and thinner film; flash and ignition points are lower than those of the Formula One. Ambersil Electrospray, which is an anti-tracking and anti-corrosive formulation for use in electrical and various other applications, is also described.

Circle **107** *for further details.*

UK-AN Connectors

The Plessey Co. Ltd. have produced an illustrated brochure describing the range of UK-AN connectors now available from the company. The brochure gives information on design, contact arrangements and wiring procedures, and also on accessory equipment, methods of mounting, special connectors and spares.

Circle **108** *for further details.*

System Simulator

A provisional leaflet No. D104-7 has been issued by Feedback Ltd., in association with Servomex Controls Ltd., which provides information on system simulator Type SS110. This simulator is designed for teaching and demonstrating analogue and simulator techniques. It can simulate a wide range of systems described by linear second-order differential equations, and is suitable for real time and repetitive scales. Type SS110 is an assembly of general-purpose transfer function units and amplifiers for analogue and simulator studies.

Circle **109** *for further details.*

Furnace Publications

The Engineering Group of The General Electric Co. Ltd. has recently published three new leaflets describing furnaces produced by the company. Leaflet E.67 refers to mains, medium and dual frequency induction furnaces supplied for heating and reheating of ferrous and non-ferrous alloys. Leaflet E.75 relates to the G.E.C. roller hearth furnaces, available in a variety of forms to meet the requirements of continuous-flow heat treatment processes. Leaflet E.78 provides information on the G.E.C. range of high-temperature furnaces, using molybdenum and tungsten heating elements for heat treatment at temperatures of up to 2,500°C. Hydrogen is used to prevent oxidation of the elements at these elevated temperatures.

Circle **110** *for further details.*

Instruments Catalogue

The Catalogue Department of Ericsson Telephones Ltd. has recently issued three new pamphlets and six price lists for the purpose of bringing up to date the Ericsson Electronic and Nucleonic Instruments Catalogue. The pamphlets describe the company's batch counters, Types 102D and 108D, preset counter, Type 188A, and Nobel load cells, Type 183A.

Circle **111** *for further details.*

"Instrument Engineer"

The October, 1960, issue of *Instrument Engineer*, Vol. 3, No. 2, contains the following technical articles: "Limnological Instruments and Water Supply", "Metering of the Wemmershoek Water Supply", "Instrumentation and Control at Boundary Dam Power Station", "Specialised Equipment for Instrument-training Purposes", and "Pressure-difference Flowmeter Head Losses". *Instrument Engineer* is published by George Kent Ltd.

Circle **112** *for further details.*

Control Engineering

A recent Negretti & Zambra publication, Brochure C100, gives an account of the contract engineering facilities offered by the company. An Australian version of the company's General Catalogue No. F25A/1, to be widely distributed in Australia, has also been published.

Circle **113** *for further details.*

Transistor Phase Meter

An illustrated leaflet from Dawe Instrument Ltd. gives detailed information of the company's transistor phase meter, Type 630. The Type 630 meter is designed to measure the difference in phase angle between two signals in the audio or sub-audio frequency range. Operation of the meter is simple and accuracy is claimed to be adequate for most applications.

Circle **114** *for further details.*

Storage Tubes

English Electric Valve Co. Ltd. have published a booklet which describes the E702 storage tubes manufactured by the company. The E702 is a storage tube of the direct view type which is designed to provide brilliant displays of information ranging from single transients and recurrent waveforms to composite pictures containing half-tones. The diameter of the usable viewing screen is 4 in. A feature of the tube is the high writing speed of 0·3 in. per microsecond which enables non-recurring microsecond transients to be displayed and photographed long after their occurrence.

Circle **115** *for further details.*

Radio-frequency Heating

The Technical Service Department of CIBA (A.R.L.) Ltd. have now published Part II of "Radio-frequency Heating". This second part of the article deals with design of jigs, inductances, laminated shapes, matching and adhesives.

Circle **116** *for further details.*

Sealectoboard

The Sealectro Corporation have recently published a bulletin which provides comprehensive technical information on "Sealectoboard", a programming device for circuit switching and component interpositioning, which enables unsightly "cord-clutter" to be dispensed with. The device permits X and Y programming without the need for patchboards.

Circle **117** *for further details.*

Registration Control

Elcontrol Ltd. Data Sheet PRC, Issue 5, provides information of the new Elcontrol registration controller. A feature of the new units is the new scanning head, SC3, using a minute photocell. Both the new one-way control unit PRC6 and the two-way control unit PRC7 embody a photoelectric gating circuit for controlling the operation of the appropriate correcting relay circuit.

Circle **118** *for further details.*

Overload and Underload Relays

Data Sheet OR/UR, Issue 2, from Elcontrol Ltd. deals with the high-accuracy current overload and underload relays produced by the company. These controllers are claimed to provide high-accuracy control of electrical loads by providing adjustable cut-out and cut-in points over a wide current range.

Circle **119** *for further details.*

Circle 179 for further information

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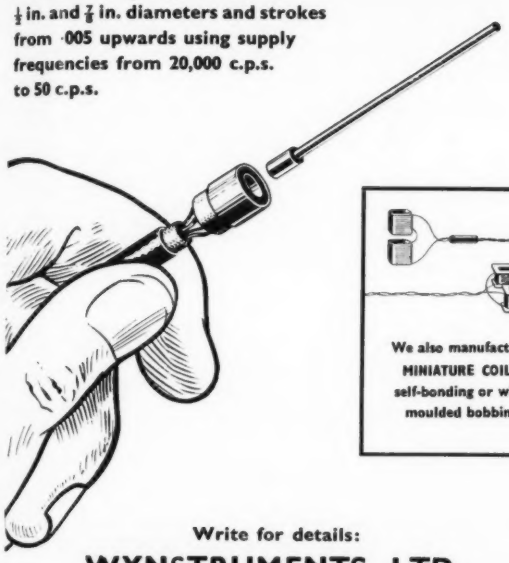

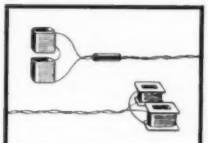

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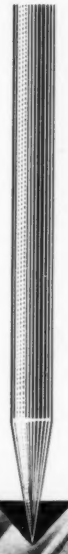

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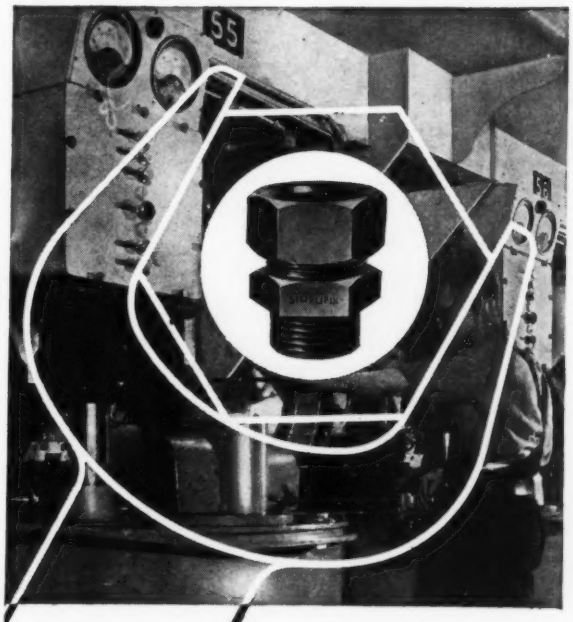

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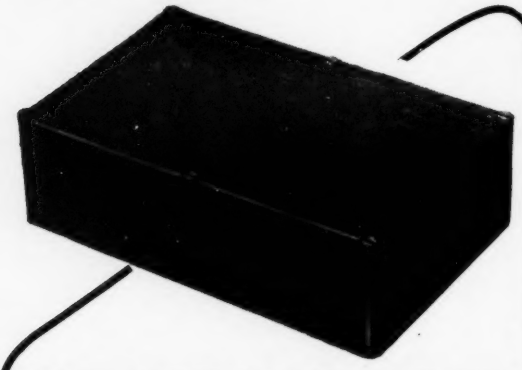

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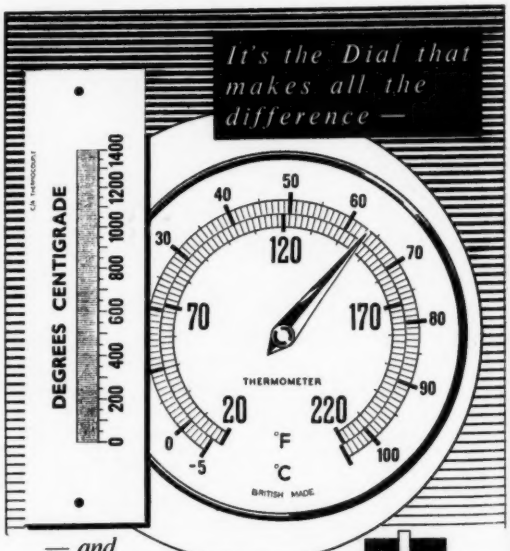
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Precision Wirewound Resistors
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Microminiaturization, Reliable Components and Cooling Techniques
G. W. A. Dummer, M.B.E., M.I.E.E., Sen. Mem. I.R.E.

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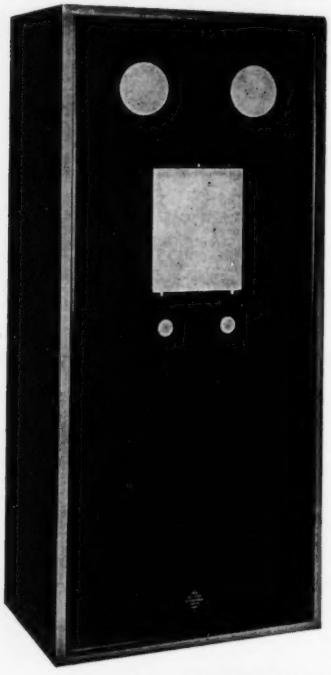

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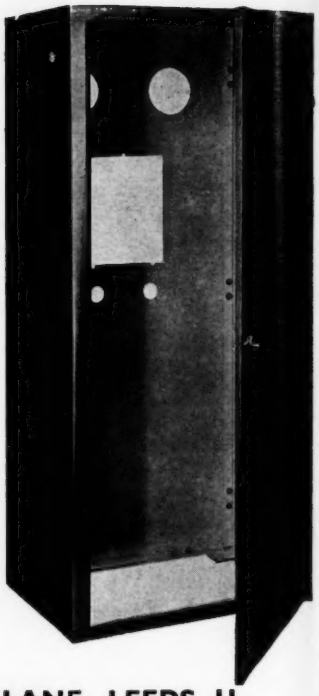

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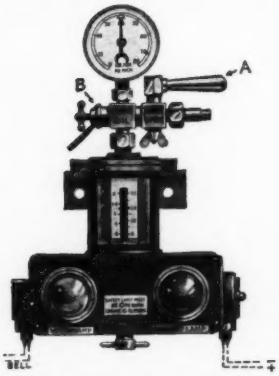

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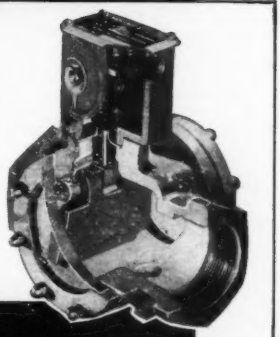

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CLASSIFIED ADVERTISEMENTS
continued on page 136

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continued from page 134

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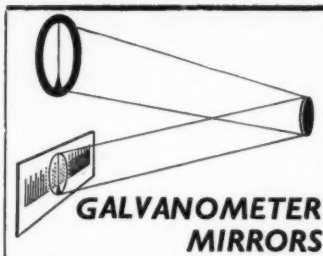

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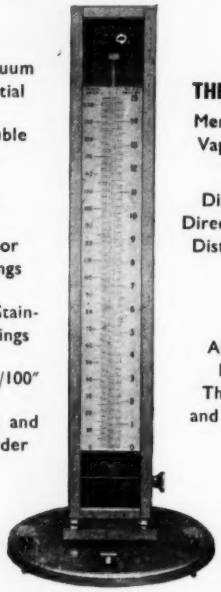

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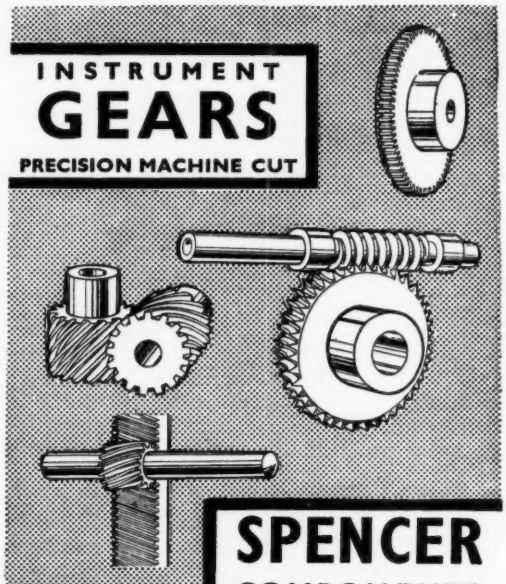

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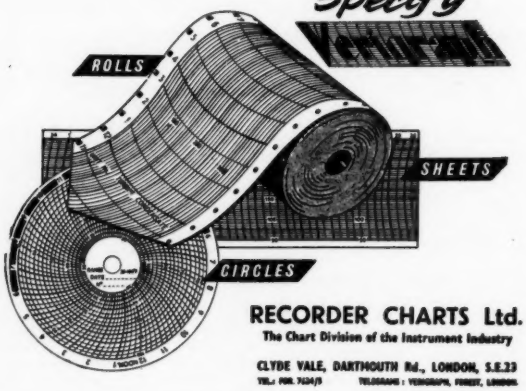

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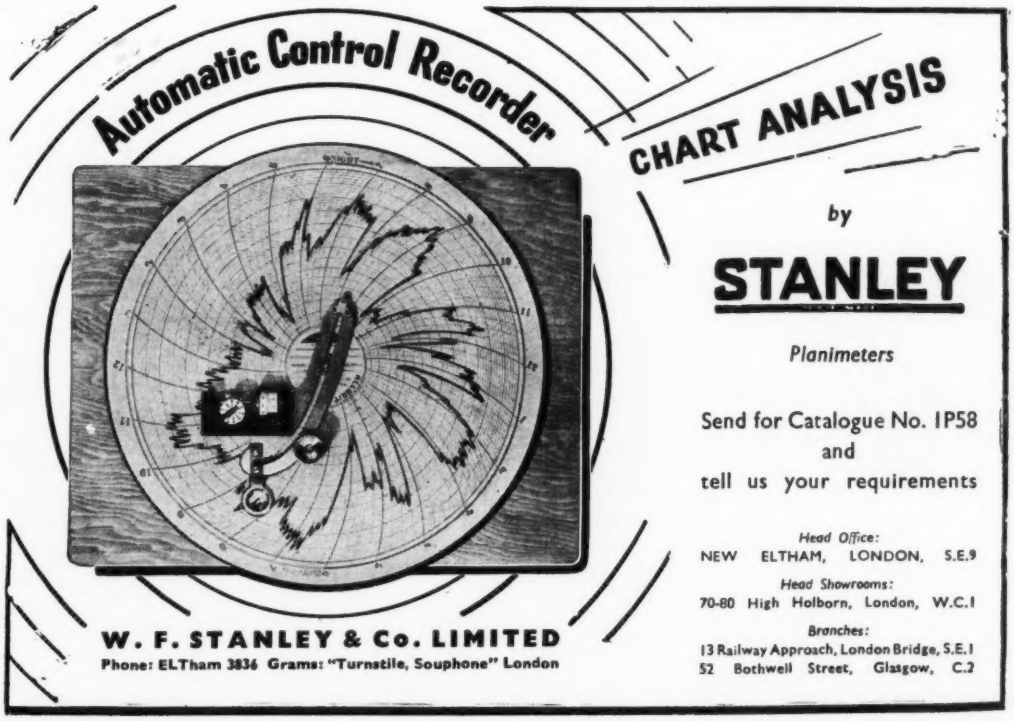

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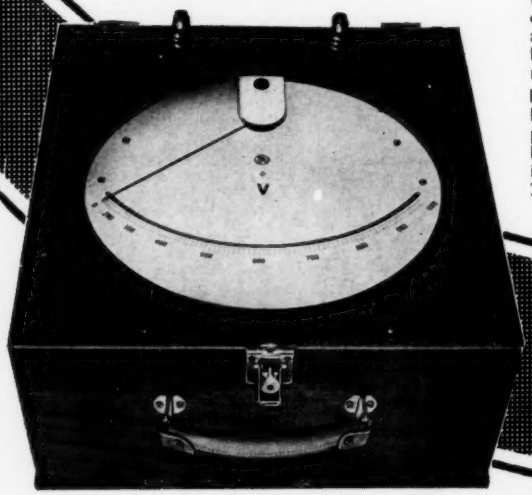

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Published by the Proprietors, United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, and printed by Herald Printing Works, York and London. Registered for transmission by Magazine Post to Canada. Annual subscription rate 50/- to be sent direct to United Trade Press Ltd., 9 Gough Square, Fleet Street, London, E.C.4, England.